Adjutant General School

Computer Science School

PRAECIPERE MILITI

Prepared by
COMPUTER SCIENCE SCHOOL

UNITED STATES ARMY INSTITUTE OF PERSONNEL & RESOURCE MANAGEMENT

FORT BENJAMIN HARRISON, INDIANA 46216

COMPUTER MACHINE OPERATOR COURSE

VOLUME I

COMPUTERS AND MEDIA

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Name ______________________________

Student Number ______________ **Class Number** ______

Finance School

CMO-1

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Personnel Management School

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INTRODUCTION

The purpose of this text is to introduce you to the basics of data processing. With this text, you will be learning about computers in general, from the media that they use to how they basically work.

This text is designed to give you some of the information necessary to perform successfully on your first test. The first test will be made up of questions from this text and the platform instruction that you will receive in conjunction with your reading assignments.

This text is divided into two areas, Reading Assignments, and Annex A.

A. The Reading Assignments is sub-divided into 10 chapters. Each chapter is further sub-divided into 8 sections. These sections are:

1. INTRODUCTION: The introduction section of each chapter is designed to introduce you to the subject matter which will be covered in the chapter.

2. OBJECTIVE: The objective section will numerically list those teaching points that you must learn from the chapter.

3. TRAINING AIDS: This section will itemize any training aids required in order to meet the objective(s) of the chapter.

4. TRAINING: This section is designed to provide the information you must receive in order to meet the objective(s) of the chapter. Each objective, as they were numerically listed, will have a corresponding paragraph. (i.e. paragraph 1 will teach objective 1.)

5. SUMMARY: This section will give you a brief recap of the subject matter covered in the chapter.

6. CONCLUSION: This section will give you insight on how the chapter will help you in the course or in data processing.

7. SELF-EVALUATION: This section will have questions that you should be able to answer before you can successfully pass the first part of the CMO course.

8. NOTES: This section is provided for you to write down any questions of points that you wish to discuss in class. This section should be used. <u>Do not hope that somebody else will ask your questions!</u>

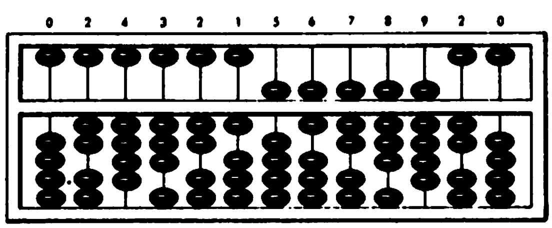
B. Annex B contains the solutions to the self-evaluation quizzes found after each chapter. After you have read a chapter do the self-evaluation quiz for that chapter, you can then check your answers in Annex A.

NOTES

Chapter 1
Introduction to Data Processing

A. INTRODUCTION: The concepts of a computer have been in existence for many years. The abacus (See Illustration #1) is a perfect example of how these concepts were used to perform calculations by sliding counters along rods or in grooves to get a numeric total for a given problem. The adding machine serves the same function by providing a numeric total by mechanical means. Adding machines were widely used in record keeping and the preparation of reports in the Army prior to World War II. As the Army grew and more information had to be maintained, a means to process this information (Data) by electrical/mechanical methods had to be adopted. Later as these processing requirements (data processing) increased, electronic computers were introduced into the Army to meet the increased requirements. As a computer operator you will be working with an electronic computer.

Illustration #1



Arithmetic is performed on an abacus by moving the appropriate counter beads up or down.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to:

1. Correctly identify and give the purpose of analog and digital computers; plus, present several examples of each.

2. Differentiate between the three basic elements of a computer system.

3. Correctly identify the five functional components of a digital computer.

4. Correctly identify those terms that are associated with the physical elements of a data processing system.

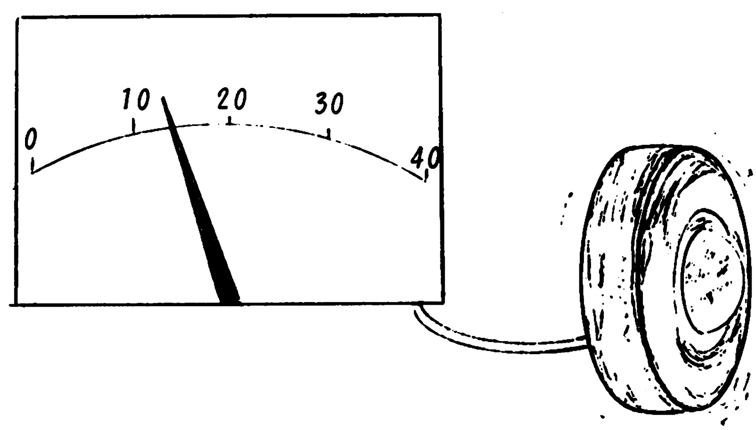
C. TRAINING AIDS: The supportive materials needed for this chapter: None.

D. TRAINING:

1. Analog and Digital Computers: There are two major kinds of computers, those called analog, and those called digital.

a. Analog Computer: An analog computer is used to measure processes which are continuous (See Illustration #2). The speedometer of an automobile is a good example of one. The speedometer needle has an infinite number of positions it can take around the graduated dial. The speed measurement may not be exact, but it is close enough for the purpose. Other examples of analog computers are the common thermometer, slide rule, scales, and the blood pressure cup.

Illustration #2



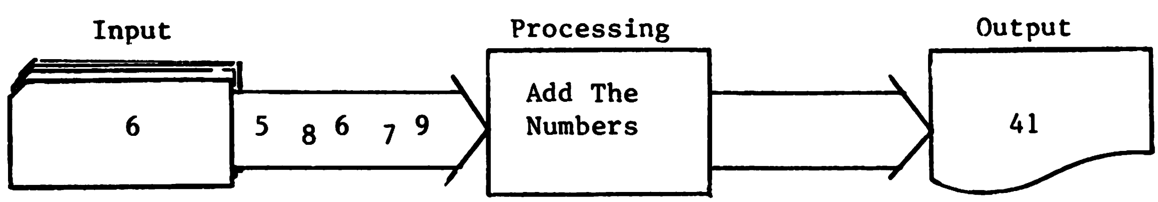
b. Digital Computer: Since an analog computer constantly performs its function (measurement) while a digital computer makes specific computions, the analog computer is basically faster. The digital computer provides far more accurate information. (It works in discrete units.) A good example of a digital computer vs an analog computer is the comparison of a digital wristwatch to a dial watch. The dial watch will display relative time while the digital watch will show the exact time to the nearest second. (Digital stop watches display to the nearest 1/100th of a second.) Analog computers are considered special purpose (speedometer for measuring speed, thermometer for measuring temperature, etc.). Digital computers can be either special or general purpose.

A general purpose computer is designed to process information for different types of problems (e.g., payroll, supply, personnel, etc.). They require instructions in order to accomplish preplanned operations. These preplanned operations will be performed and the desired results will be accomplished with very little human intervention.

Since you will most likely be working with a digital computer, the rest of this course will pertain to digital computers.

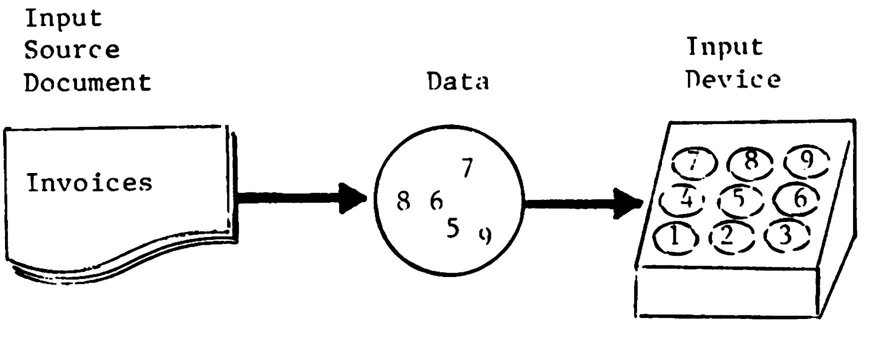
2. The Three Basic Elements. The three basic elements of any digital computer system, no matter how small or how large it may be, are Input, Processing, and Output (See Illustration #3).

Illustration #3



a. Input: The term input is used to describe the entry of data and/or instructions into a computer system. The keys (keyboard) on an adding machine are used to feed data into the machine. Therefore the keyboard would be considered an input device. The numbers that were keyed into the machine would be considered input data. The document such as the invoice, pay record, or supply requisition, from which the information was gathered for entry into the adding machine is referred to as an input source document (See Illustration #4).

Illustration #4



The information on the source document will not be accepted by the adding machine unless it is converted to a medium that it can interpret. For instance, a purchase order might show the price of an item as "Thirty Seven Dollars and Ninety five cents." Since an adding machine cannot accept letters, we must convert the way the price is shown on the purchase order to "$37.95" in order to input it to our adding machine. Likewise, a computer system will not accept data until it has been converted to a medium it can interpret. Once the data has been converted, it will be put into the system by the use of one of several input devices. The type of input media for a computer system depends on the type of input devices that come with the system.

b. Processing: The manipulation of data within a computer system is called processing. Once the data has been converted to an input medium and entered into the system through an input device, the data can now be processed to satisfy a predetermined requirement. The type of processing done by the computer system is controlled by a detailed step-by-step set of instructions called a computer program. The Basic Functions of processing are: Classifying, Sorting, Calculating, Editing, and Selecting.

(1) Classifying: The term "classifying" is used to describe the function of assigning a group of related facts (data records) to a given category. An example of this is to classify graduates of the Computer Operator AIT Course as 74D's while graduates of the Infantry AIT Course would be classified as 11B's.

(2) Sorting: Sorting is the arranging of data records in a desired sequence. One example is to arrange the data records of the students in a Computer Operator AIT course in alphabetical order according to their last name.

(3) Calculating: Calculating or computing is another basic function of processing. This is accomplished when the computer adds, subtracts, divides or multiplies data to produce useful results.

(4) Editing: One function of editing is to determine that the input data is correct. An example of this is making sure that the input data pertains to personnel rather than equipment, when the computer is running a personnel system.

(5) Selecting: Selecting is the processing function of pulling, from a large amount of data, those data records or items that require special attention. An example of this is selecting computer operator records from a personnel data file to determine how many operators are in an organization.

c. Output: The term output is used to describe the data that comes out of the computer system. In the example of the adding machine, the output of the machine is the numeric total of all the numbers. The output media in this example would be printed output. The type of output media of a computer system depends on the type of output devices that are connected to the system.

3. Five Functional Components: The five functional components of a digital computer are: input unit, storage unit, control unit, arithmetic/logic unit and the output unit (See Illustration #5).

a. Input Unit: The input unit is that component which performs the function of reading or translating input data into the computer readable language. Once the data has been put on a medium that the computer system will accept, an input device, which is part of the input unit, will read the input data and send that information to the computer.

b. Storage Unit: The storage unit of a digital computer is that component which is used to store data or computer instructions. The Storage Unit can consist of both internal and external storage.

(1) Internal Storage: Internal storage is normally used to temporarily hold data and computer instructions for the actual processing of that data. This type of storage resides in the actual computer itself.

(2) External Storage: On the other hand external storage is used to store data or computer instructions outside the computer. The reading or writing of the data and computer instructions to and from this external storage is accomplished through the use of input/output devices.

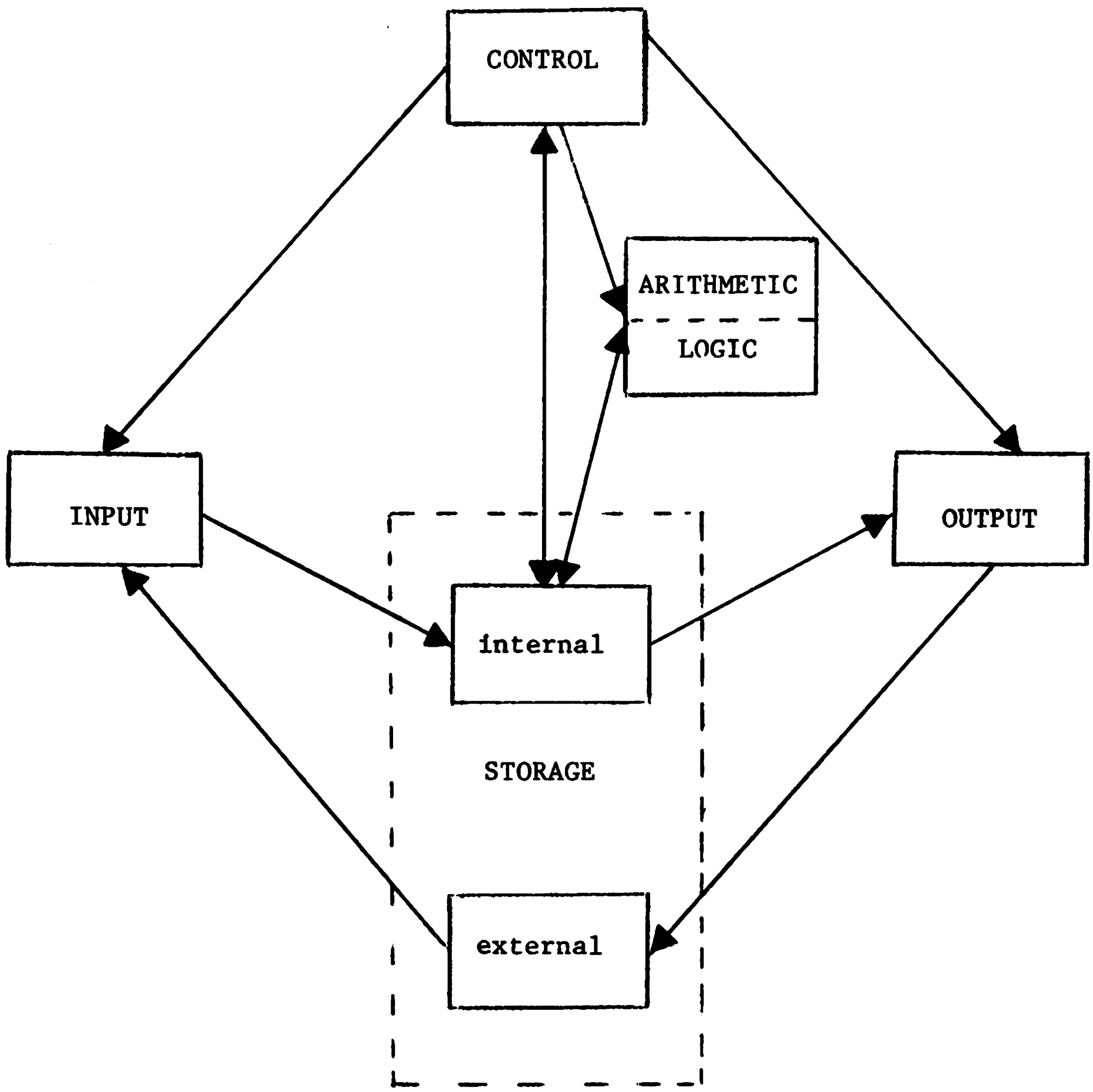
c. Control Unit: The control unit is that functional component which directs the computer in the overall performance of operations. This functional component receives from storage an electronic copy of each instruction, one at a time, in a predetermined sequence. These instructions are interpreted to determine what type of operation is required, then the control component activates the necessary electrical impulses to perform that operation. In other words, all computer instructions are executed under the immediate direction of the control component.

d. The Arithmetic/Logic Unit: The arithmetic/logic basic functional component is responsible for the calculation or other manipulation of data. The arithmetic/logic component receives an electronic copy of data from the storage component and performs the arithmetic operations such as addition, subtraction, multiplication and division as well as the logical operations primarily concerned with testing. This ability to test a given condition is the result of programmed computer instructions.

e. The Output Unit: The output unit is that component which performs the function of writing and/or interpreting output data. Once the data has been processed the computer will instruct an output device to generate the output. Output may be considered as modified data or updated information. It may be in machine readable form or it may be in human readable form.

Illustration #5

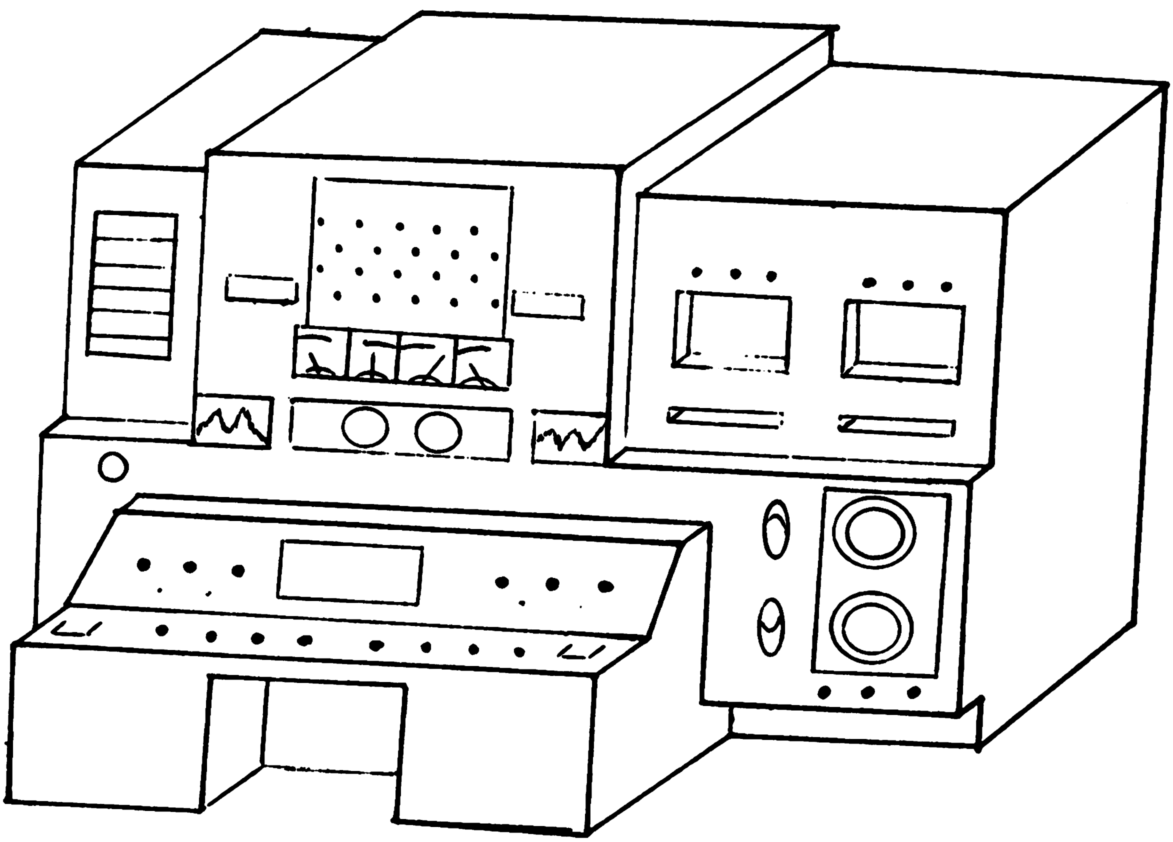
The Five Functional Components



4. Physical Elements: The physical elements of a computer center are hardware, software, and personnel.

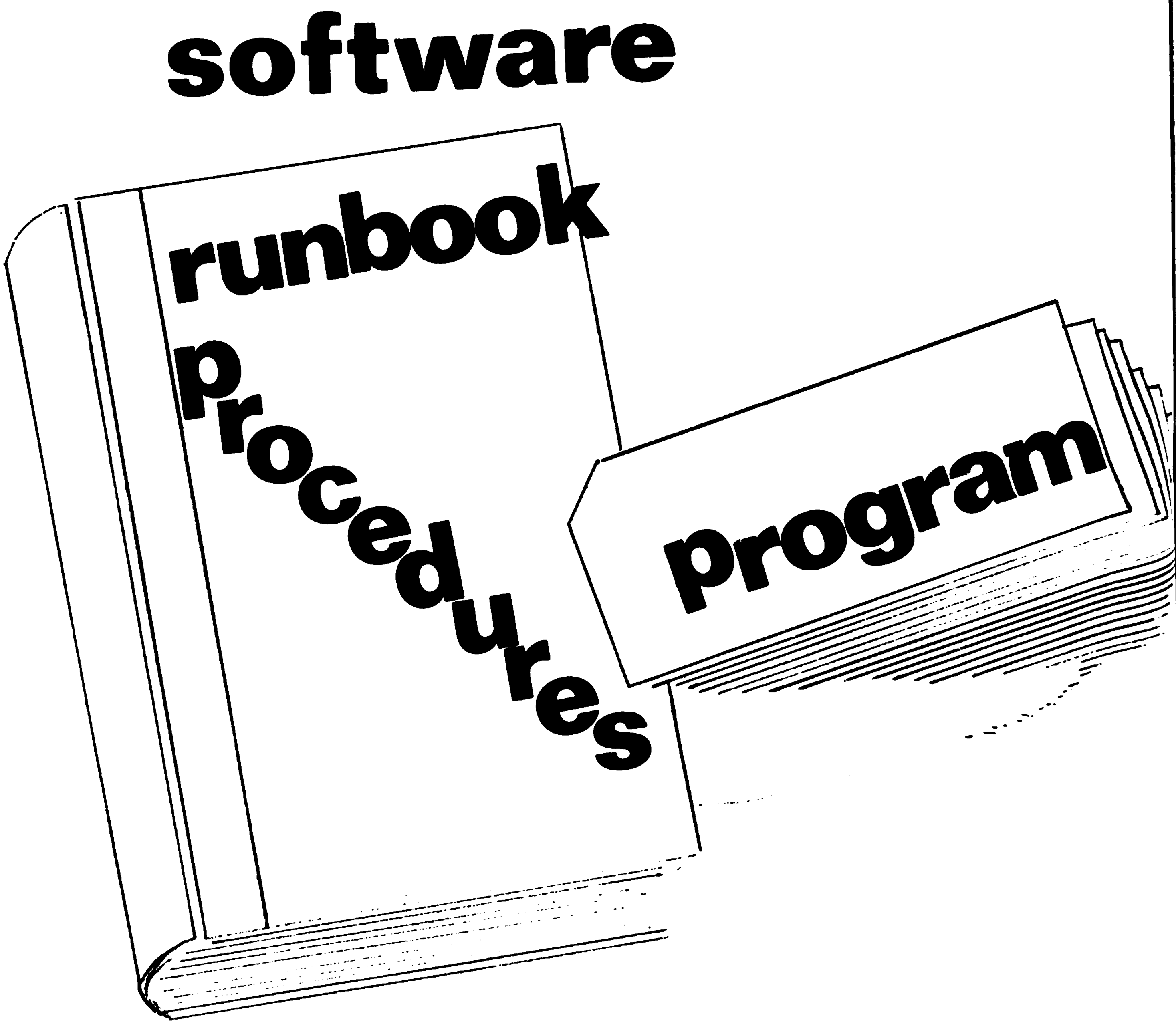
a. Hardware: Hardware is the actual nuts and bolts. (See Illustration #6). It is the machinery of an electronic data processing system. Hardware consists of the computer and the input/output devices that are connected to the computer. All this machinery makes up the hardware of a computer center.

Illustration #6



HARDWARE

b. Software is another physical element of a computer center (See Illustration #7). Software is the procedures and programs found in a computer center. Examples of software are computer systems manuals, computer system documentation and computer instructions (computer programs).



c. The final physical element of a computer center is its personnel. These are the folks that are responsible for the data received, processed, and distributed as output. You, as a computer operator, will be part of this team of data processing personnel.

Other personnel that you will have some contact with in your installation are:

(1) The Data Processing Activity (DPA) Managers: DPA managers range from the one who has overall responsibility for the activity and installation to supervisors of sections of the DPA (e.g., Programming, Maintenance and Operation Sections).

(2) Programmers: These individuals are responsible for writing computer instructions (programs) and maintaining the programs used in the activity.

(3) Systems Analysts: A system analyst is that person who makes a detailed analysis of how a system works. He/she is the one who will design change to a system to improve or automate it to better serve the people who use the system.

(4) Shift Supervisor: This individual will be your immediate supervisor. He is responsible for the overall operation of the computer room during his shift to include the supervision of the operators.

(5) Computer Scheduler: He is responsible for the scheduling of all processing on the computer system.

(6) Input/Output (I/O) Clerks: You most likely will perform this job sometime in your career. I/O Clerks perform the function of handling and accounting for all computer input and output in the activity.

(7) Librarian: This is another job you may perform. The Librarian is responsible for maintaining the magnetic library of the data processing activity.

(8) The User: Even though the user may or may not be part of the computer center, without the user the installation would have no purpose. The user is the command or individual that the DPA services. The user is the one that uses the results of the processing in his daily management and activities.

E. SUMMARY: During this block of instruction, we have learned the following:

1. The difference between analog and digital computers.

2. The three basic elements of a computer system which are input, processing, and output.

3. The five functional components of a digital computer which are the input unit, storage unit, control unit, arithmetic/logic unit, and output unit.

4. The three physical elements of a data processing system which are hardware, software, and personnel.

F. CONCLUSION: Automatic Data Processing has spread to every phase of Army life. The quality of work you do in the field will affect many people's lives, to include your own. Become a professional in your field by starting now to learn all you can about data processing in this course and in the United States Army. Your future depends upon you.

INTRO TO DATA PROCESSING

SELF-EVALUATION

Situation: You are in a classroom about to take a Science and Arithmetic test, your instructor gives you the following items to solve the test problems and to record your findings.

A. A calculator
B. A thermometer
C. A pencil
D. An eraser
E. A question sheet
F. An answer sheet
G. A paper clip
H. A speedometer

QUESTION 1. From the items listed below, select the one which is an example of an input source document.

A. Calculator
B. Paper clip
C. Question sheet
D. Pencil
E. Answer sheet
F. Thermometer
G. Eraser
H. Speedometer

QUESTION 2. From the items listed below, select those examples of an analog computer.

A. Answer sheet
B. Question sheet
C. Paper clip
D. Speedometer
E. Thermometer
F. Pencil
G. Eraser
H. Calculator

QUESTION 3. From the items listed below, select the five functional components of a digital computer.

A. Output
B. Input unit
C. Storage unit
D. Input
E. Arithmetic/logic unit
F. Output unit
G. Control unit
H. Processing

QUESTION 4. From the items listed below, select the three basic elements of a computer system.

A. Output
B. Input unit
C. Storage unit
D. Processing
E. Output unit
F. Sorting
G. Input
H. Control unit

Question 5. From the list below, select the basic functions of processing.

A. Sorting
B. Printing
C. Calculating
D. Editing
E. Inputing
F. Classifying
G. Outputing
H. Selecting

QUESTION 6. From the items listed below, select the personnel physical elements of a data processing activity.

A. Operator
B. Card Reader
C. Disk Drive
D. Librarian
E. Control programs
F. System manuals
G. I/O Clerk
H. Tape Drive

NOTES

NOTES

Chapter 2

Punch Card Input and Output

A. INTRODUCTION: One type, of input and/or output medium largely used by the Army today, is punch card. Punch cards will have holes punched into them in a specific order, and normally will be produced by a device called a key punch, or by a computer output device called a card punch. Two examples of punch cards are; the government payroll checks we receive and the Savings Bonds we purchase. The specific hole combinations can represent characters of the alphabet, the 10 numeric characters of the decimal system, and even special characters such as a question mark (?). Once these holes are punched into a card, the card can be used as input to a computer through the use of an input device called a card reader. The input punch card can either have data or computer instructions, and in turn the computer can punch holes into unpunched cards (blank cards) for human use (i.e. payroll checks). The particular punched card we will be studying in this chapter is called the "80 column general purpose card".

B. OBJECTIVE: The objective of this chapter is to give you the necessary information required to:

1. Identify the characteristics of an "80 column general purpose card."

2. Identify alphabetic, numeric or special characters, and interpret 2 prepunched cards.

3. List the Card Input and Output Devices.

4. Identify Punch Card Error Conditions.

5. Identify Proper Card Handling and Storage Requirements.

C. TRAINING AIDS: The supportive materials required for this chapter: NONE

D. Training: Since computers in the Army use punched cards as input and output, it is necessary that you become familiar with the "80 column general purpose card".

1. Characteristics: Basic familiarization of a punch card includes the identification of the cards columns, rows, punch positions, and nomenclature.

a. 80 Columns: Each alphabetic, numeric, or special character is represented by a hole or holes punched into a given column. The punch card we are studying has eighty columns, with column number 1 being on the left side of the card.

b. 12 Rows: Each of the eighty columns has 12 positions in which a hole can be punched. The punch positions are identical for each column; therefore the card is considered to have 12 rows.

c. Punch Positions: As stated earlier, each card column has 12 punch positions:

(1) The top punch position is referred to as a 12 punch.

(2) The 2nd punch position is referred to as an 11 punch.

(3) All other punch positions are numbered, 0 thru 9, down the card column and their punch position is referred to by their assigned numbers. (E.g. a hole punched in position 0 is called a zero punch.)

d. Nomenclature: Finally, as we speak of the punch card, we refer to particular areas of the card by name.

(1) Face: The face of the card is that surface that will normally have printing of some type on it.

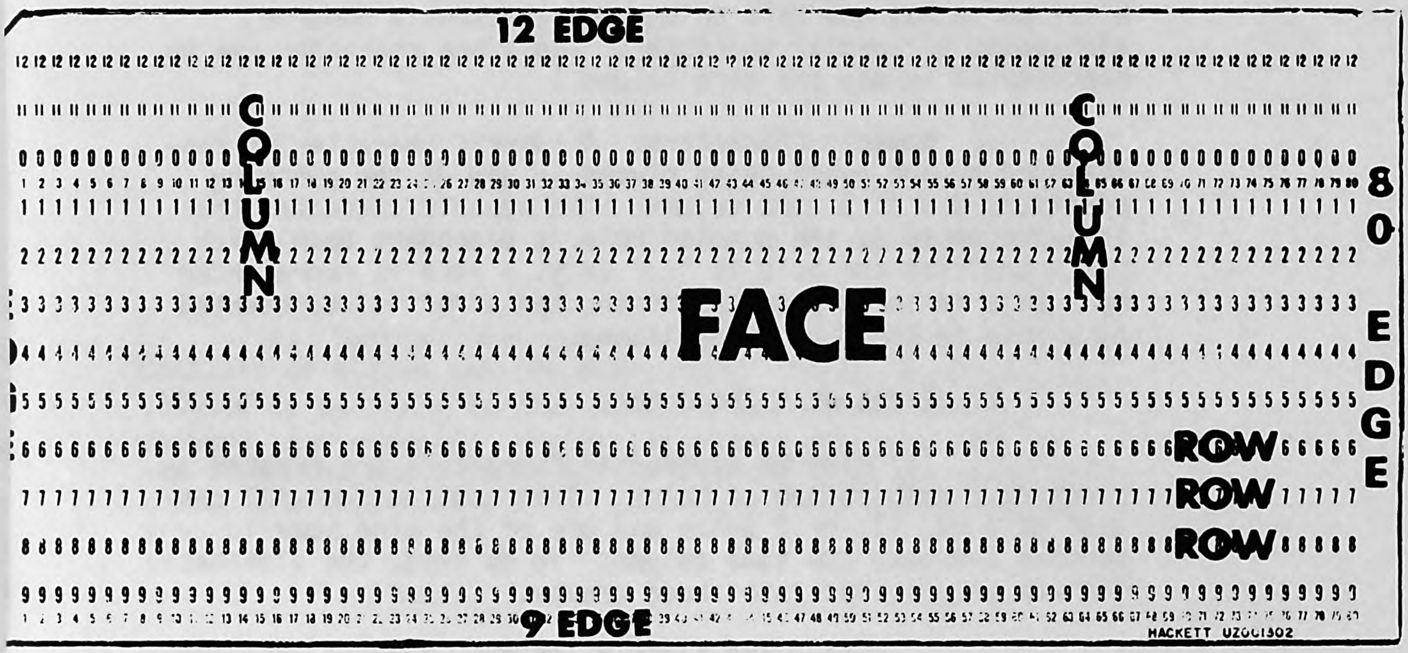
(2) Back: The back of the card is the reverse surface of the card.

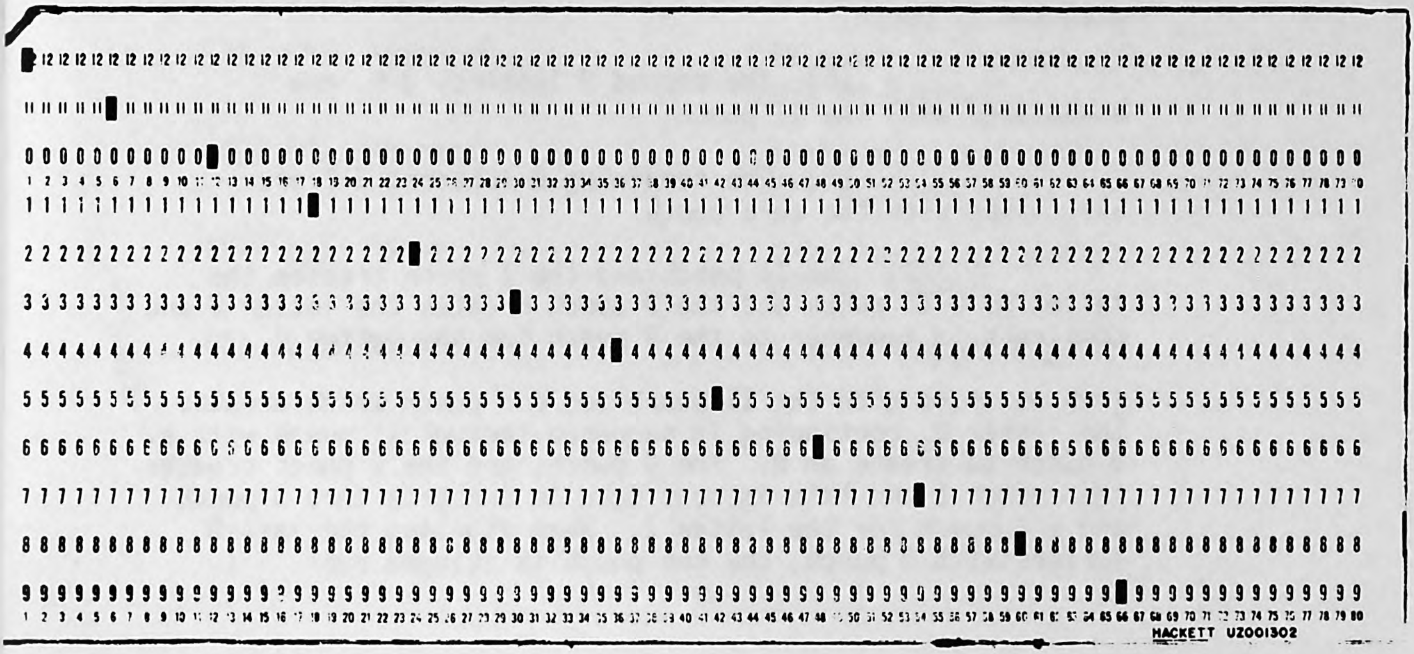
(3) 12 Edge: The top edge of the card, as we look at it, is nearest the 12 punching position. This top edge of the card is therefore referred to as the "12 edge."

(4) 9 Edge: The bottom edge of the card is nearest the 9 punching position, therefore it is referred to as the "9 edge."

(5) 1 Edge: The left edge of the card is near the first column, it is called the "1 edge."

(6) 80 Edge: The right edge of the card is near the last (80th) card column, it is called the "80 edge."





2. Identifying Characters: A special code (hole combinations) is used to represent characters in the "80 column general purpose card". This code is called, the Hollerith Code, in honor of its founder, Dr. Herman Hollerith. The Hollerith Code uses a specific hole punch or hole punch combination in any one card column to represent a numeric, alphabetic or special character. (Only one character can be represented in any one card column.)

a. Numeric Characters: A numeric character is represented by one punch being placed in any of the punching positions 0-9 in a card column. The numeric character that is represented by the punched hole is dependent upon which punch position the hole is in: (e.g. a zero is represented by a hole in the 0 punch position, and a "6" is represented by a hole in the 6 punch position).

b. Alphabetic Characters:

(1) The 26 alphabetic characters are created by punching a combination of holes. This combination will consist of a 12, 11, or 0 punch and one of the nine numeric punches 1-9 into the same column. To do this, the alphabetic letters are divided into three groups.

(a) The first 9 letters, A-I are associated with the 12 punch.

(b) The second 9 letters, J-R, are associated with the 11 punch.

(c) The remaining 8 letters, S-Z are associated with the zero punch.

(2) The 12 punch and the 1 punch creates the letter A, a 12 punch and the 2 punch creates the letter B and continues in sequence to the 9 punch for the letter I.

Then we start with the 11 punch and a 1 punch which creates the letter J, continuing in sequence through 11 punch with a 9 punch to create an R. The 0 punch, and the 2 punch creates the letter S and this is continued in sequence thru 0 punch and a 9 punch for the letter Z. When starting the last 8 letters with 0 punch, the one punch is skipped over.

At this time it is necessary to mention that a zero punch is a numeric punch and is usually represented by a 0 with a slash through it: "Ø", and the alphabetic character O is represented by an O, or an O with a line under it: "O̲".

12 Punch and	11 Punch and	0 Punch and
1 = A	1 = J	
2 = B	2 = K	2 = S
3 = C	3 = L	3 = T
4 = D	4 = M	4 = U
5 = E	5 = N	5 = V
6 = F	6 = O	6 = W
7 = G	7 = P	7 = X
8 = H	8 = Q	8 = Y
9 = I	9 = R	9 = Z

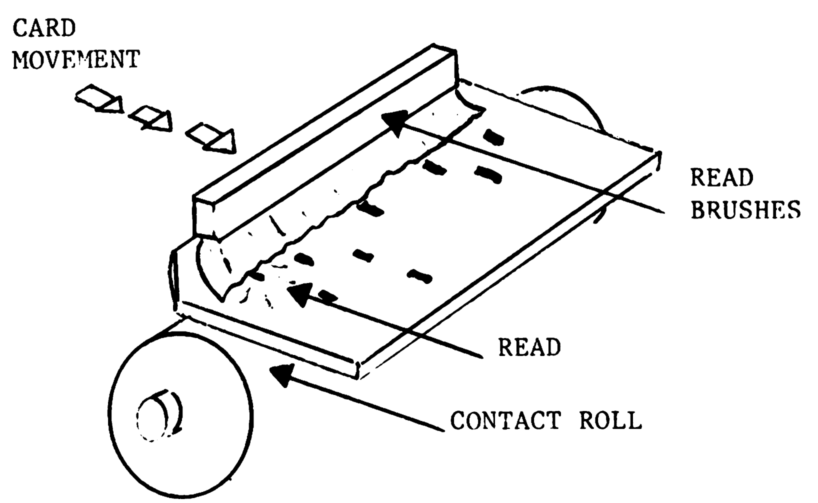
c. Special Characters: The 80-column punching system consists of eleven special characters. These characters are created by punching various combinations of punches in a column. For example: the dollar symbol ($), consists of the 11 punch, the 3 punch and an 8 punch. The six special characters which you will be concerned with in this course are:

(1)	(/)	Slash	0 - 1 punch
(2)	(&)	Ampersand	12 punch only
(3)	(*)	Asterisk	11 punch, a 4 punch, and an 8 punch.
(4)	(%)	Percent	Zero punch, a 4 punch, and an 8 punch.
(5)	(,)	Comma	Zero punch, a 3 punch, and an 8 punch.
(6)	(')	Apostrophe	5 punch and an 8 punch

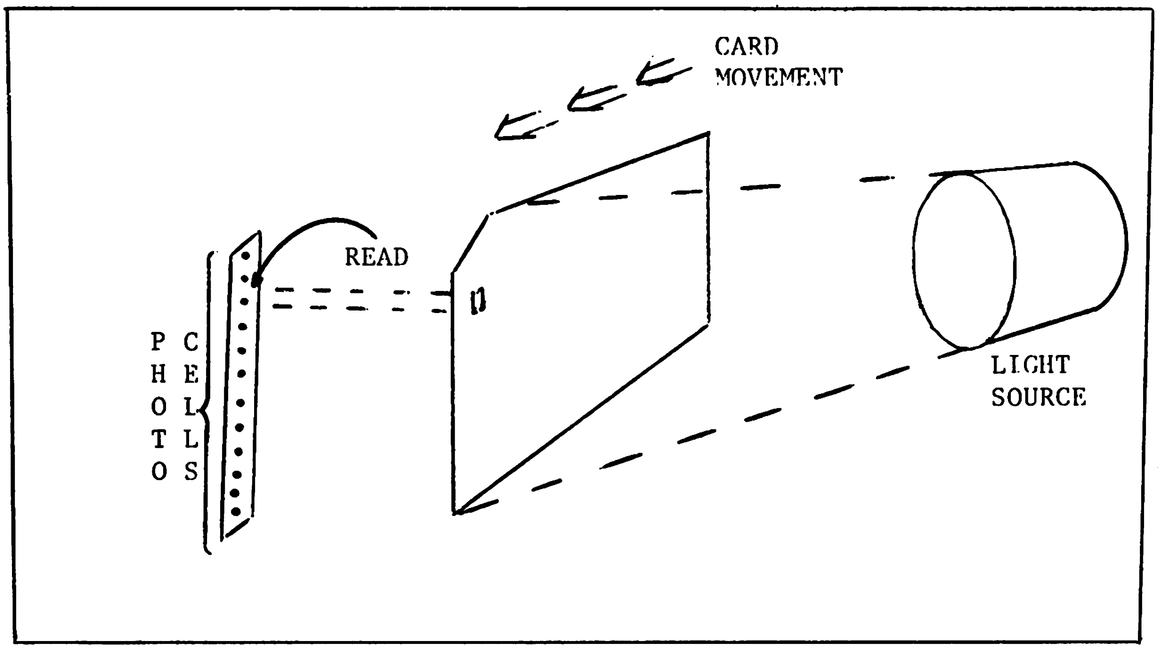
3. Card Input and Output Devices: The computer will normally have two types of punch card devices attached to it. The input device is called a card reader, while the output device is called a card punch.

a. Card Reader: The card reader, in a computer configuration may be either a brush type or photoelectric type.

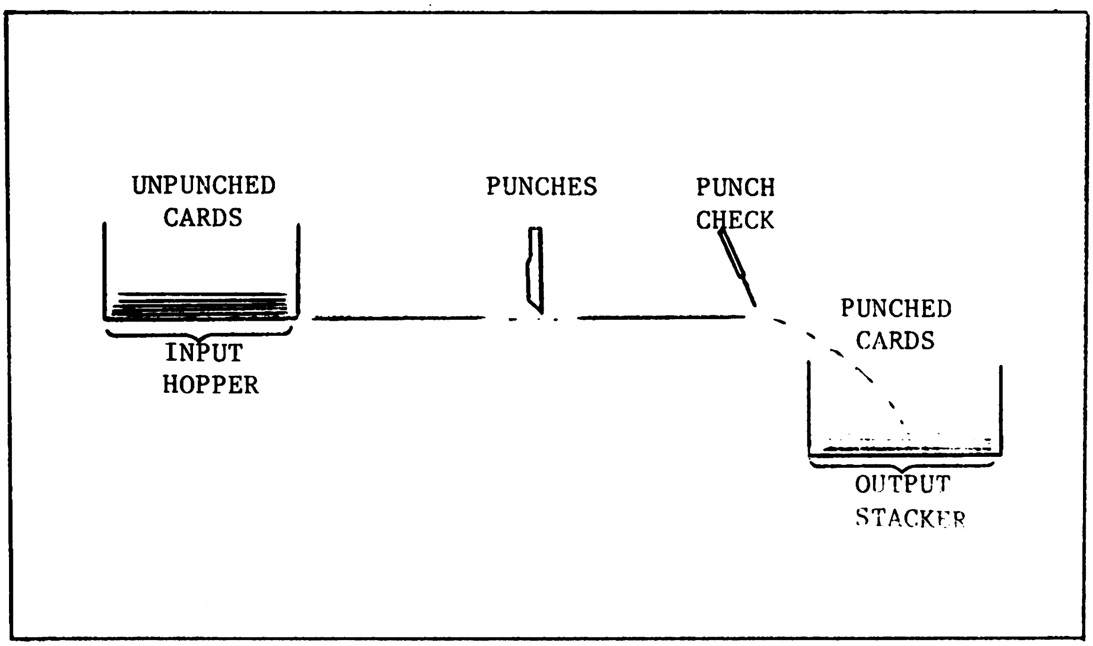
(1) Brush Card Reader: On the brush type card reader, the holes on a punched card are sensed by passing the card between a set of read brushes, and an electrically charged metal drum. As a punched hole passes between the brush and metal drum, the metal brushes will make contact with the drum. This contact will cause an electrical impulse, which will be sensed by the card reader. These electrical impulses will automatically be converted to language which the computer will understand. We call this language Machine Language. This machine language is then sent to the computer.



(2) Photoelectric Card Reader: On the photoelectric type card reader, the holes on a punched card are sensed by passing the card between a set of photoelectric cells and a light source. As a punched hole passes between the light source and a particular photoelectric cell, the light source will be sensed by that cell, and in turn will be converted to machine language. Like the brush reader, once all the card has been read the machine language interpretation is then sent to the computer.



b. Card Punch: This output device is used to punch holes into blank cards with data received from the computer. When data (information) is sent by the computer, the card punch will punch hollerith code information into blank cards.



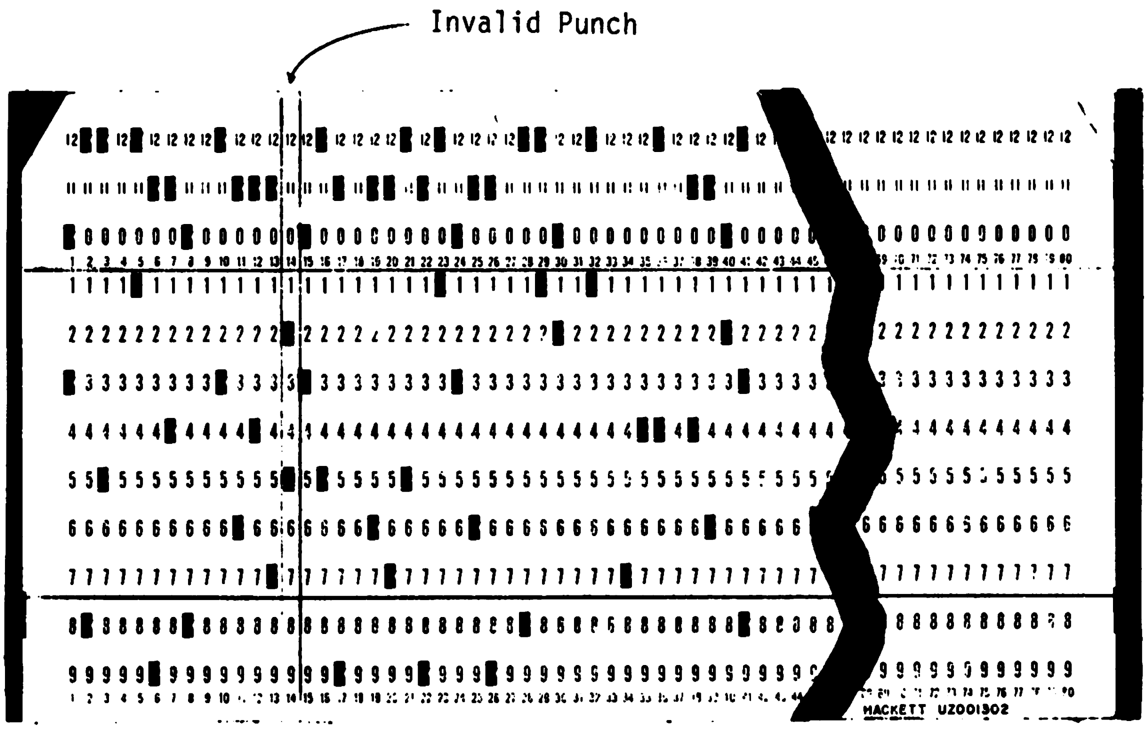
4. Card Error Conditions: As a computer operator you will most likely encounter error conditions that will not allow you to feed, read, or punch cards. This section is to give you a general idea of what types of cards will cause these error conditions.

a. Feed Errors: A card that has been warped, torn, spindled, mutilated, stapled or even bent on the edges will not be accepted by the card reader or the card punch.

b. Invalid Punches: A card that has an invalid combination of punches will be rejected by the card reader. This invalid combination of punches is when there is more than one punch in punch positions 1 through 7 in any given card column. (See Illustration #5).

c. Off-Punched Cards: The term "off-punched" refers to cards in which the holes are not exactly where they belong. The holes may be too high or too low in relation to the correct punching position, or too far to the left or right.

Illustration #5



5. Proper Card Handling and Storage Procedures: As a computer operator you must be aware of the proper handling and storage of punch cards:

a. Handling: In handling cards, care should be taken not to tear, mutilate, spindle or staple cards.

b. Storing of Card Stock: Cards should be kept in a warm, dry area. When storing these cards, they should be stored under pressure in card containers. By storing them under pressure, you eliminate the chances of card warpage. Warpage is caused by improper stacking and storage of cards. It is also caused by improper climate control in the storage area. The location of storage is very important when dealing with data processing cards.

E. SUMMARY: In this chapter, we studied how holes in an "80 column general purpose card" served as input and output for a computer through the use of input and output devices. We itemized the hole combinations used to represent alphabetic and numeric characters, and gave some examples of special characters. Also, examples of error conditions with cards were given and finally the proper handling and storage procedures were mentioned.

F. CONCLUSION: The Hollerith code is the oldest and most commonly used coding system used to represent data. Your ability to interpret this coding system will be a tremendous asset to you in the field and will help you easily grasp other coding systems used in data processing.

NOTES

SELF-EVALUATION

1. Item B is:

    a. A 12 punch.
    b. A 1 punch.
    c. A zero punch.
    d. In row 1.
    e. In column one.
    f. On the one edge.
    g. On the zero edge.

2. The 12 edge is indicated by item:

    a. A.
    b. B.
    c. C.
    d. D.
    e. E.
    f. F.
    g. G.
    h. H.
    i. I.
    j. J.

3. Item C is:

    a. On column 12.
    b. A zero punch.
    c. An 11 punch.
    d. On row 12.
    e. On the 12 edge.
    f. A zero punch.
    g. On column 11.
    h. A 12 punch.
    i. On row 11.

4. Item H is:

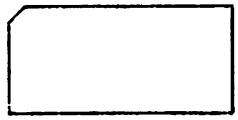
    a. A zero punch.
    b. On column 18.
    c. In column 7.
    d. In row 18.
    e. A 7 punch.
    f. In row 11.
    g. In column 11.
    h. The 7 edge.

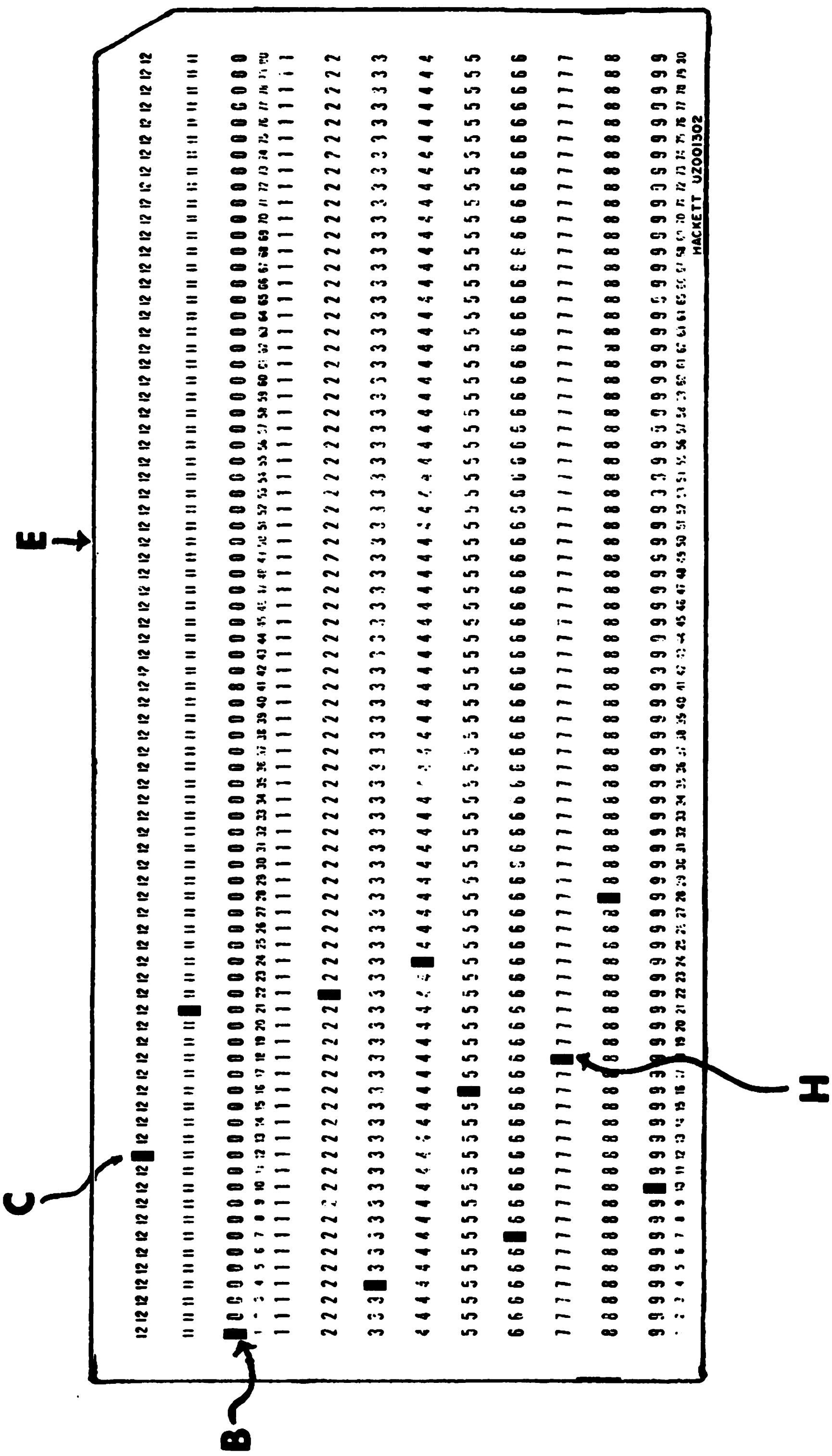
5. The Hollerith code of a 12 punch and a 4 punch represents the character:

    a. D.
    b. G.
    c. K.
    d. O.
    e. 0
    f. W.
    g. /.
    h. &.
    i. 4.
    j. 6

6. The Hollerith code of a 12 punch only represents the character:

    a. D.
    b. G.
    c. K.
    d. O.
    e. 0.
    f. W.
    g. /.
    h. &.
    i. 4.
    j. 6.




E
C
B
H

7. Select from the list below, the examples of computer card damages that are caused by humidity or temperature changes:

a. Laced cards.
b. Warped cards.
c. Card rusting.
d. Stacked cards.
e. Conditioned cards.

8. Identify the two types of card readers:

a. Character-recognition.
b. Optical reader.
c. Photoelectric.
d. Validity reader.
e. Brush reader.
f. Interpreter reader.

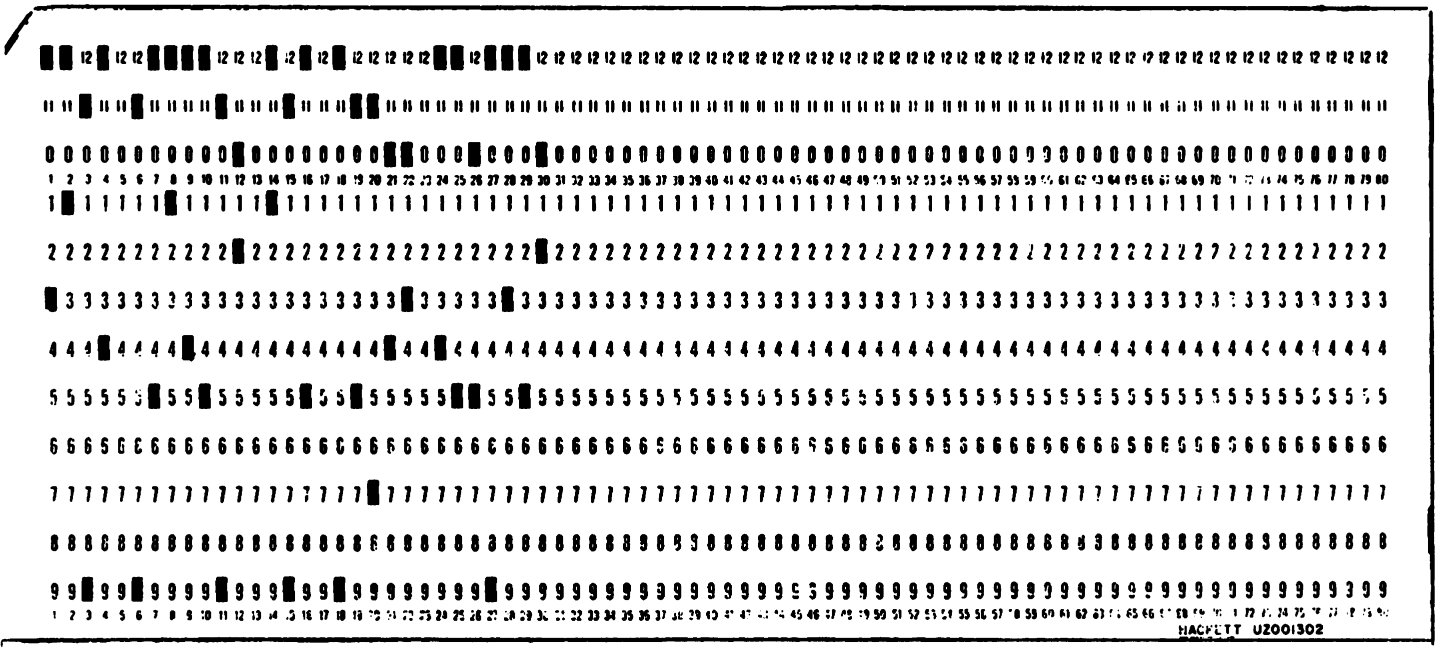
9. The example of an invalid punch in a card is:

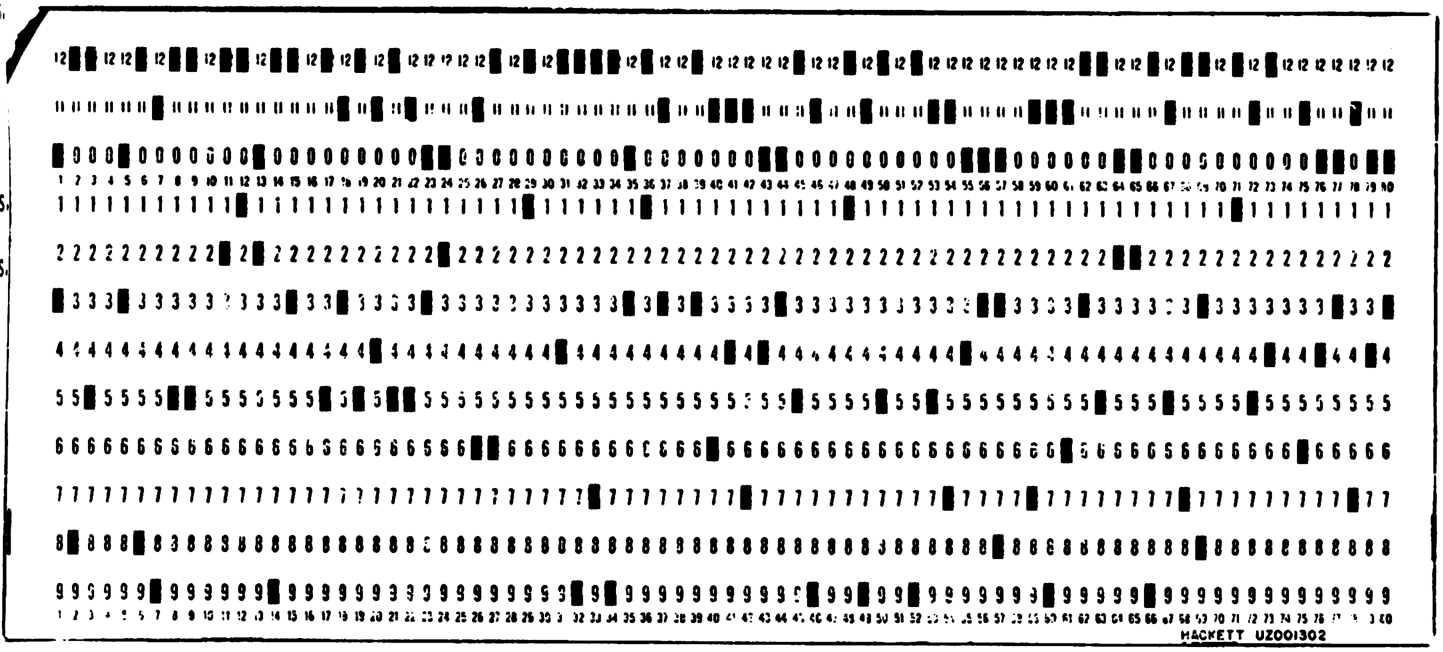
a. The card is warped due to humidity or temperature changes.
b. The card column has a punch hole combination cf 12, 2, 5 punches.
c. The card has off-punched holes.
d. The card column has a punch hole combination of 12, 3, 8 punches.
e. The card edge is bent due to improper handling procedures.

10. The example of a feed error is:

a. The card is warped and cannot be read through the reader.
b. The card column has a punch hole combination of 12, 2, 5 punches.
c. The card has off-punched holes.
d. The card column has a punch hole combination of 12, 3, 8 punches.
e. The card was being read by an optical reader.

11 - 12. Interpret the two cards shown below.





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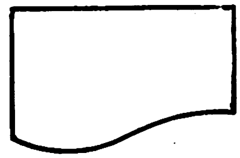


CHAPTER 3

COMPUTER FORMS

A. INTRODUCTION: In the previous chapter, you discovered that one type of input/output media was punch card. You learned that the punched card is a type of media which can be used to enter information into the computer and that can be used for receiving information from the computer. However, if you do not know the Hollerith Code, or if there was a great amount of punched card output from the computer, you would have a difficult time interpreting that information.

Another output medium, designed to provide readable output (English language) to the people who cannot understand computer type language, is the computer printout (Computer forms). These forms come in various sizes and shades of color; they may be plain like normal typing paper or may be a preprinted form (e.g. leave and earnings statement). The computer printout is produced by an output device called a printer. Printers can be used for preparing reports for the user, or special type printers can serve as a communication link between the computer and the computer system operator. As a computer system operator, it will be your responsibility to insure that the printed output is of the highest possible quality.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. Two types of printers.

2. Two types of impact printers.

3. Two types of line printers.

4. Two types of serial printers.

5. The characteristics of computer forms.

6. Form storage requirements.

7. The purpose of the printer carriage.

8. The two methods for controlling paper movement on a printer.

9. The characteristics of carriage control tape.

10. The proper procedures in preparing a carriage control tape.

11. The operator responsibilities in regard to the computer printer.

C. TRAINING AIDS: None

D. TRAINING:

1. Types of Printers: A computer system can have one or two types of printers, the two types are impact and nonimpact.

a. Impact Printer: An impact printer will make physical contact with the printing mechanism on the computer form (paper). One good example of an impact printer is the standard office typewriter. The character you select will strike the inked ribbon against the form resulting in the desired character appearing on the form. Since impact printers make physical contact, they are able to produce carbon copies of the original form. The computer system can provide more than one copy of a report in the same time that it would take to produce one original copy.

b. Nonimpact Printer: On the other hand, the printing mechanism of a nonimpact printer does not make physical contact with the form. Instead it will accomplish printing by an electrostatic or photo-chemical process. A good example of this is the Xerox machine that uses special treated paper to provide printed forms. (An exception to this is the ink jet printer, where tiny droplets of ink are squirted onto the computer form to create a desired character.) Though nonimpact printers cannot produce carbon copies, some models are capable of printing the same amount of several original copies in less time than impact printers take using carbon copy forms.

A computer operator may work with both types of printers, impact and nonimpact, however, the rest of this chapter and course will deal with the operational characteristics of impact printers.

2. Types of Impact Printers: There are two categories of impact printers; they are line printers and serial printers.

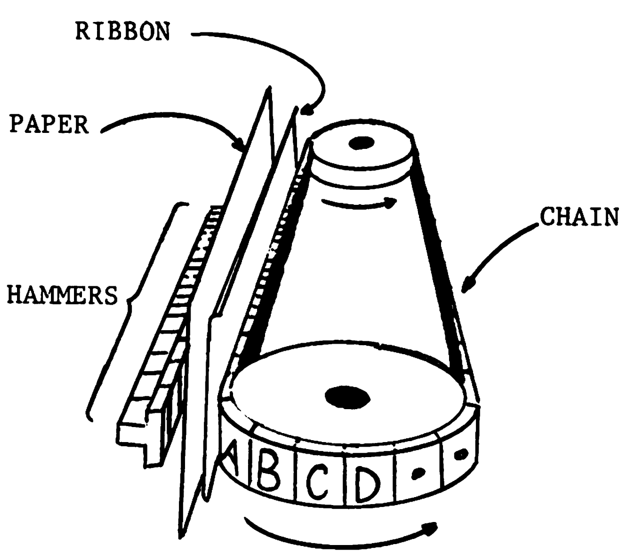
a. Line Printers: A line printer is capable of receiving all the characters that will be printed, on a line from the computer, before it starts printing. Once it starts printing, it may print two or more characters, on the line at the same time. Normally line printers are used for large quanities (high volume) of output.

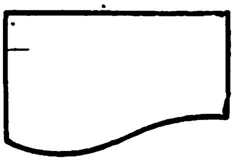
b. Serial Printers: A serial printer will normally print only one character at a time. Each character may be printed as it is received from the computer. The serial printer will normally be used to produce a small amount of output, and sometimes will be used as a communication link between the computer system and the operator.

3. Line Printers: There are 2 types of line printers that will be covered in this section, the chain printer and the drum printer.

a. Chain Printer: The chain printer normally will consist of five sections arranged side by side. In a five-part chain, a complete set of alphabetic, numeric, and special characters are included in each section. The chain is mounted horizontally to the line of print and revolves from left to right at a constant rate of speed (See Illustration #1). As the chain is rotating, and as the required character passes a desired print location, one of the 132 hammers located behind the computer form will be given instructions to strike the form, against the ribbon and character. Because the chain printer can have up to 132 hammers, it can have up to 132 characters printed on one line. The speed of chain printers vary, however, it is recognized as one of the fastest impact printers on the computer market.

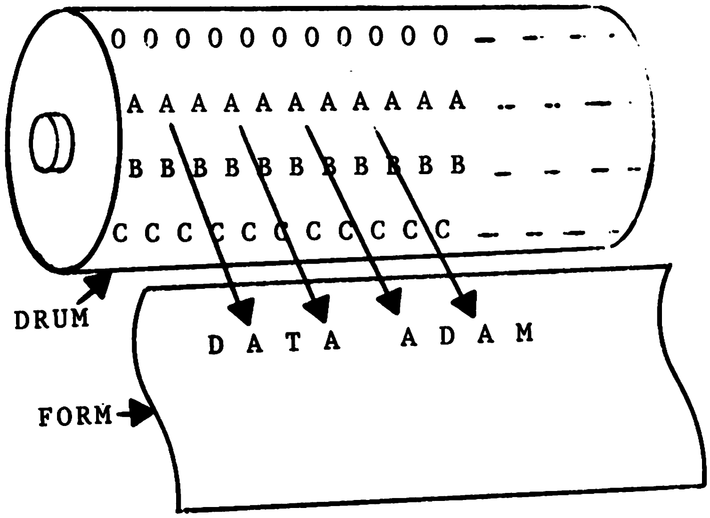
Illustration #1





b. Drum Printer: Another high speed printer is the drum, it uses a solid cylindrical drum with raised characters (See Illustration #2). Each character that can be printed by the drum printer will have its own row across the drum. If the letter A is required in print positions of a given line of print, the selected hammers will be given instructions to strike, the form against the ribbon and drum. Any print position requiring the character B is printed in the same manner. This sequence of events will continue until the whole line is printed. A drum printer, like the chain printer, is also recognized as a high speed printer.

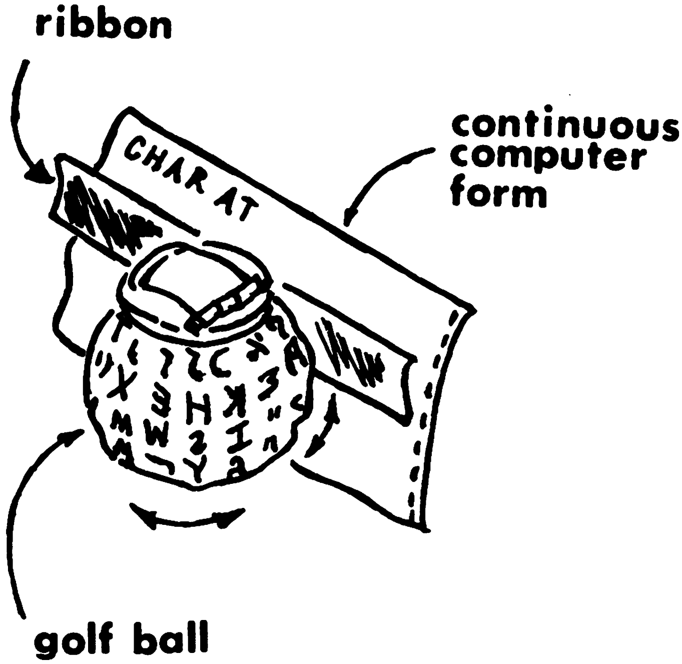
Illustration #2

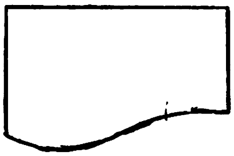


4. Serial Printers: As mentioned earlier, line printers are normally used for high volume output, and are recognized as output devices. On the otherhand, serial printers are normally used for a small amount of printout, and may be part of an inquiry device. An inquiry device is used for two-way communications with the computer system. The computer displays processing information, on the printer, for the operator to read. The printer also displays any information or instructions that the operator may key into the computer system. The two types of serial printers that will be discussed in this section are the golf ball and matrix.

a. Golf Ball Printer: The printing mechanism of a golf ball printer strongly resembles the printing mechanism of an IBM selectic typewriter (See Illustration #3). However, a golf ball printer can receive instructions or commands from a computer, while a typewriter cannot. The print head of this printer, similar in shape to a golf ball, strikes the printer ribbon and form to leave the impression of the selected character. This type printer has a removable print head so other print heads with different styles of print can be used.

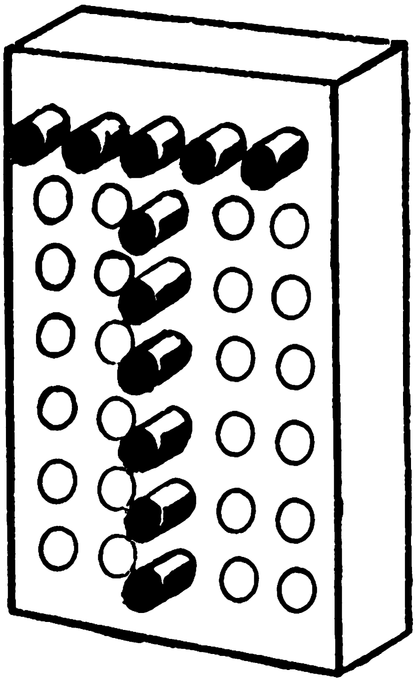
Illustration #3



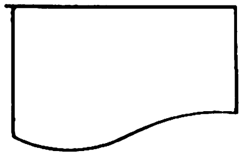


b. Matrix Printer: This type printer, like the golf ball, may also be used with inquiry devices. A matrix printer consists of wires (pins) that are arranged in a block (See Illustration #4). Behind the block of wires is a set of hammers that corresponds with each wire. When a character is selected to be printed, the appropriate hammers are selected to strike the wires which will create the impression of the character to be made on the computer form.

Illustration #4

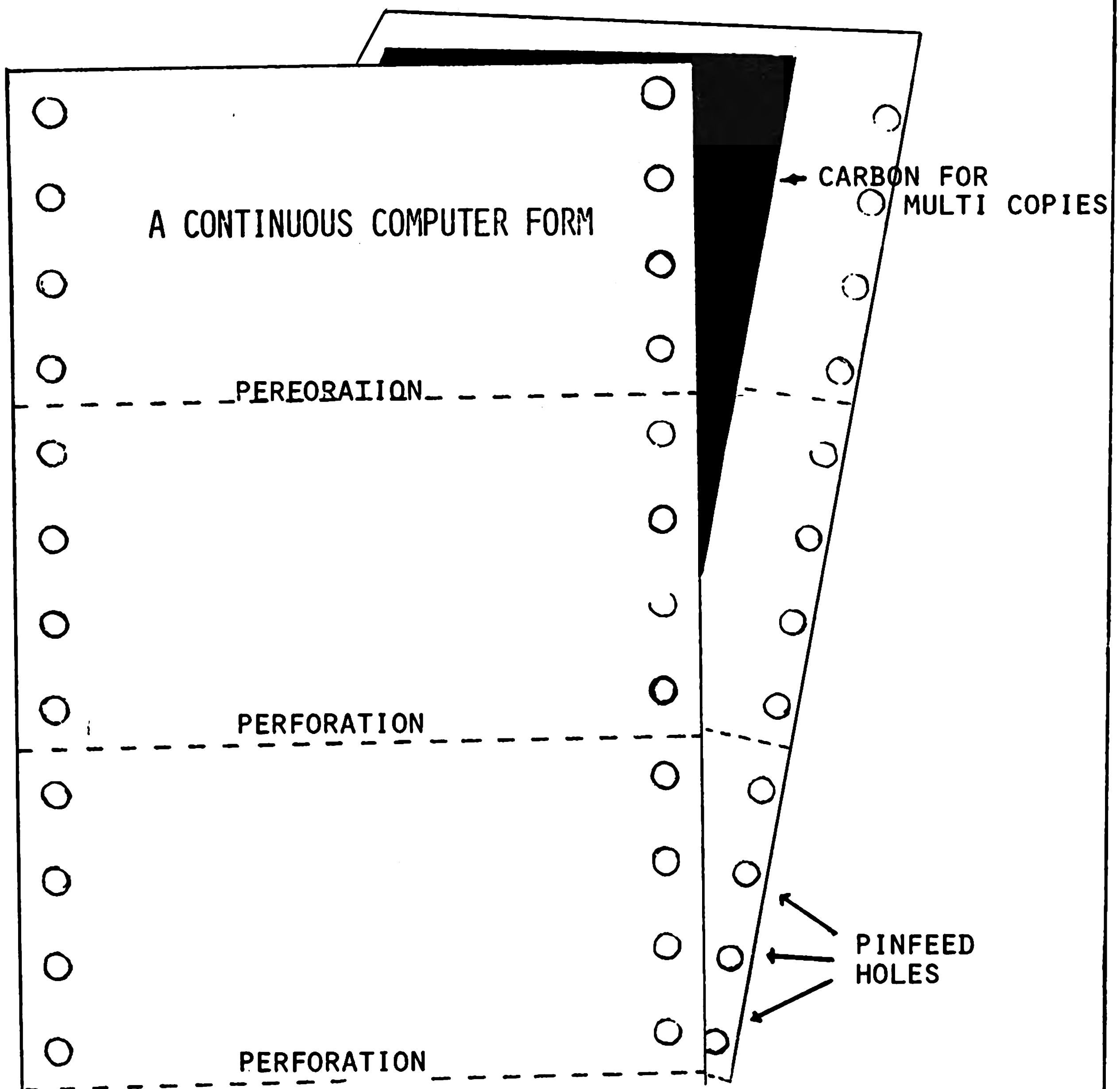


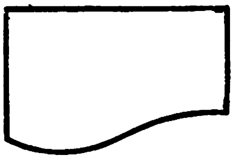
BLOCK ACTIVATED WITH A CHARACTER "T"



5. Computer Forms: As mentioned earlier, computer forms come in various sizes and shades of color. The most common is the standard computer form ("1413"). The term "standard" is used because this form is the most common and widely used computer form. In this section you will be introduced to the characteristics of the computer form; in that they are continuous, have pinfeed holes, and can be multipart (See Illustration #5).

Illustration #5



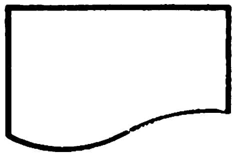


a. Continuous: When typing a report, that requires more than one page on a typewriter, the typist must take time to remove the typed form and insert a new form. At this point consideration must be given to the relative slow speed of a typist in comparison to the higher printing rate of computer printers. At the printer speed, a computer operator could easily spend all his time changing forms.

With the idea of an individual form being connected to another form by a perforation, the computer printer can print a complete page and eject-the-page when it is finished. Because the forms are now connected, by ejecting the printed page, the printer can supply itself with a new page. The purpose of computer forms being continuous is for efficiency.

b. Pinfeed holes: The purpose of pinfeed holes is to allow the printer to move the form whenever a new line of print is required, or to eject a printed form so that a new form can be printed on.

c. Multipart: The term multipart is used to describe computer forms that are capable to providing more than one copy of a report. Quickly the term carbon copy comes into mind, some multipart forms will have carbon forms inserted between each sheet, however, some multipart paper is carbonless. Carbonless multipart forms use a special chemical coating that reacts to the impact of the printer and inturn creates an image of the selected character on the copy.



6. Form Storage Requirements: In accordance to Army Regulation 18-7, Data Processing Activity Management, Procedures and Standards, there are storage requirements for ADP supplies, which includes computer forms that you should adhere to:

a. Computer forms will be stored in an area that will provide adequate environmental and fire protection. At a minimum, they must be stored in a controlled environment, like the computer room, for the purpose of conditioning it to the environment in which they are to be used. (If this is not done, you may have problems using the form.)

b. Shipping cartons will be stacked in a manner that will not damage the contents. Normally, the cartons will be stacked no more than three cartons high. Cartons of computer printout forms should be stored on pallets to eliminate the possibility of drawing dampness from the floor. Computer printout forms will be kept neatly arranged to provide ready access to the materials. High standards of cleanliness in these areas will be adhered to in order to reduce risk of fire and to insure that the computer room is not contaminated.

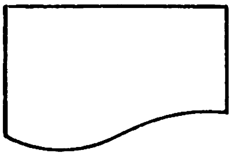
7. Carriage: The purpose of the printer carriage is to automatically feed, space, skip, and eject the computer form through the printer.

a. Feeding: Is the term used to describe the rapid and accurate positioning of a computer form to be printed on, by the computer printer.

b. Spacing: Is the term used to describe the advancing of the computer form from print line to print line.

c. Skipping: Is the term used to describe the high speed advancement of the computer form for two or more print lines. In other words it is the term used to describe the high speed advancing of a form through the carriage without printing.

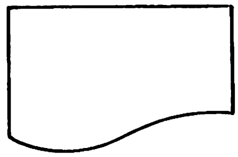
d. Ejecting: Is the term used to describe the automatic removal of the computer form, from the printing mechanism, once the required printing on that form has been completed.



8. Controlling Paper Movement: Printers have a unit that will control the movement of paper through the printer. The printer model, will determine the type of unit that comes with that printer. This section will introduce you to "Vertical Forms Unit" and the "Carriage Control Unit". The function of each unit is to insure that the computer form is at the correct position for printing. It will let the computer know when a new form is positioned (first line of print) and when a form is completed (last line of print). In other words these units are designed to control the movement of the carriage.

a. Carriage Control Unit: This unit controls the movement of the computer form with the use of carriage control tape. The tape is punched with holes to indicate printing positions of the computer form. Once the operator properly loads the required forms at the first line of print, and the correct carriage control tape at the corresponding punched hole, no special attention need be given to the printing of the form. The computer can now instruct the printer, with the use of the carriage control unit, to provide computer printout.

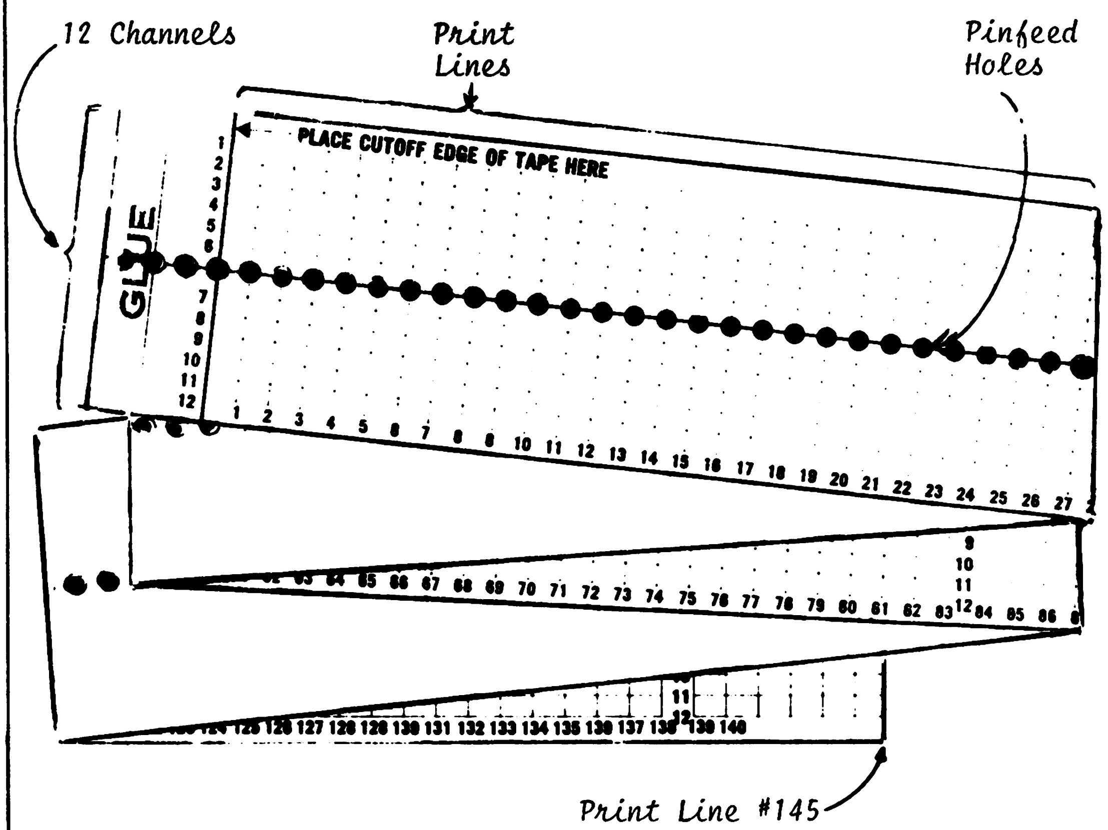
b. Vertical Forms Unit: Many newer type printers now incorporate a Vertical Forms Unit (VFU) that determines the print positions electronically. With this type printer, the only thing the operator has to insure is that the correct forms are loaded and are at the first line of print. The use of the Vertical Forms Unit is considered by some to be superior to the carriage control method. The carriage control tape can tear, and can easily get lost.

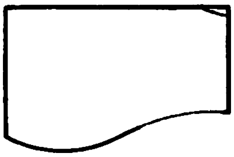


9. Carriage Control Tape: As a computer operator, in the US Army, the high speed line printers that you will be working with will most likely have a Carriage Control Unit. For this reason it is important that you become familiar with the characteristics of carriage control tape.

a. Characteristics: The carriage control tape, that will be covered in this course, will have 12 vertical lines the length of the tape. These 12 vertical lines are called channels. Along the tape, 145 lines extend across the width of the tape. These 145 lines are called print lines. Along the length of the tape are pinfeed holes. These pinfeed holes are used to move the tape around the Carriage Control Unit for sensing any punch holes (See Illustration #6).

Illustration #6





b. Punch Hole Requirements: It is the responsibility of the programer, who writes the computer instructions for printing, to supply instructions as to where holes are to be punched. However, after the instructions on preparing a control tape are prepared, and the first one has been created, it will be the operator's responsibility to prepare any replacements or back up carriage control tapes. Instructions to the computer will determine the hole punch combination that represent print positions on the form. The usual hole punch combinations are as follows:

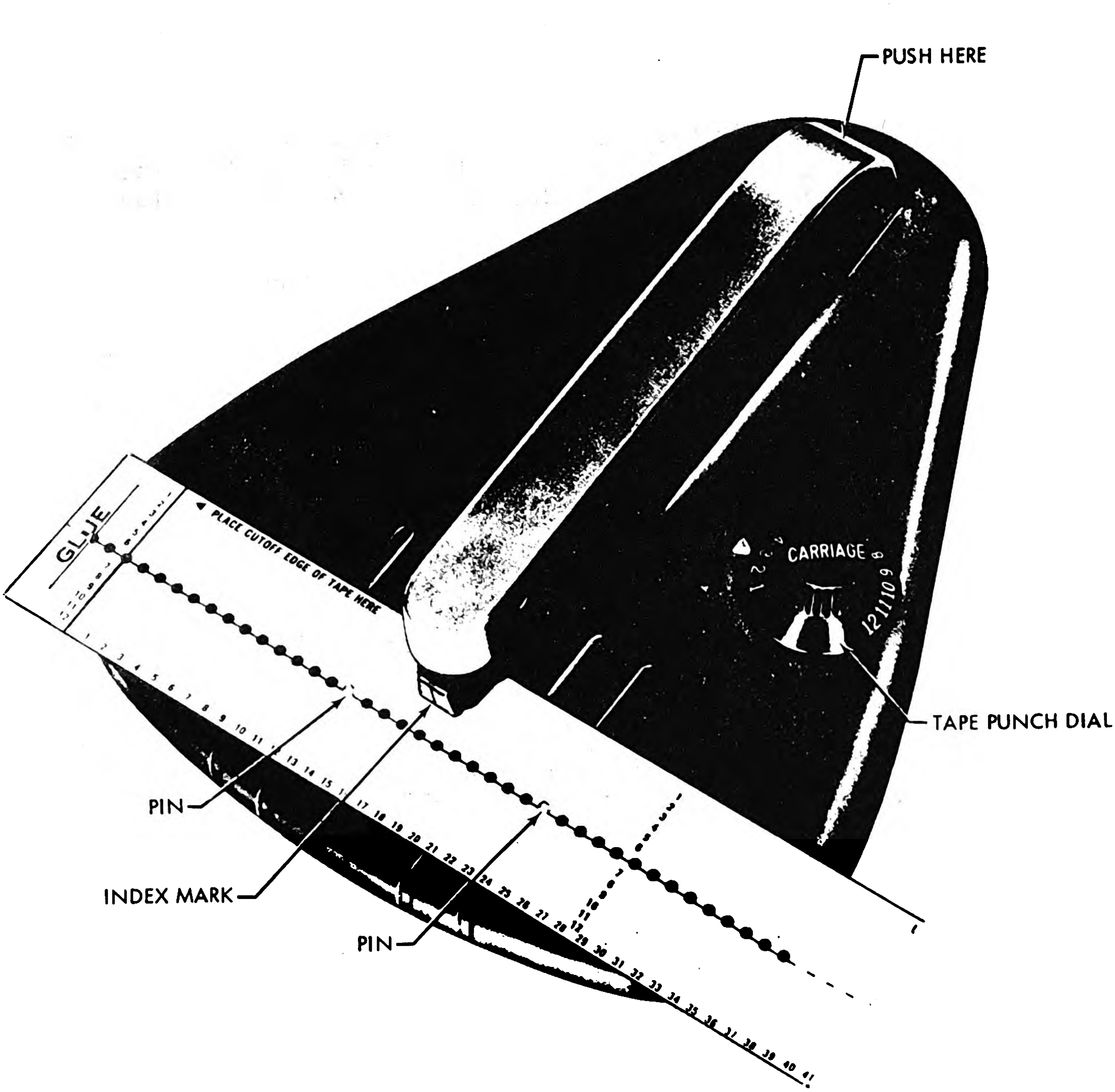
(1) Channel 1: Usually, computer instructions will indicate, any hole punched in channel 1 will represent the first line of print of the computer form.

(2) Channel 12: The computer will normally receive instructions that a hole punched in Channel 12 will represent the last line of print.

(3) Channels 2 thru 11: Channels 2 thru 11 will normally be used to position the form anywhere between the first and last line of print. This will allow the printer to skip at a high rate of speed until it senses the desired punch. A good example to illustrate this is your leave and earnings statement, where the first three lines of print are near the top of the form but the fourth line of print may be near the middle of the form. By the computer receiving an instruction to skip to Channel 2 and print the fourth line of print, the carriage control unit can skip at a high rate of speed until a channel two is sensed. Again, it is the programers responsibility to initially supply instructions as to which channel punch the carriage control unit will be looking for and on what print line it is suppose to be on.

10. Preparing A Carriage Control Tape: A small compact punch is provided for punching the tape (See Illustration #7). The tape is first marked in the channels in which the holes are to be punched. When marking a carriage control tape for a computer form, one of two methods can be used.

Illustration #7



a. Duplicate Previous Carriage Control Tape: If the previously used carriage control tape is available, all the operator has to do is punch corresponding holes on the new tape, cut the tape so that it is the same size, and glue the tape in the same method as the previous tape was glued.

b. Prepare New Tape From Instructions: The operator needs to read the instructions to determine, where the first line of print is, where the last line of print is, any special print lines that may be required, and what channel punch will represent those print lines. Once the operator has done this, the following procedures can be performed.

(1) Lay the tape next to the edge of the form that is to be controlled with the top line of the tape (immediately under the glue portion) even with the top edge of the form.

(2) Mark the tape in channel 1 where it matches up to the first line of print.

(3) Mark the tape in any channel that is identified to represent a line of print the form is to skip to. (This is done in the same way channel 1 was marked.)

(4) Mark the tape in channel 12 where it matches up to the last line of print.

(5) Repeat the first four steps as many times as the length of the tape (22 inches) allows. (When the tape controls more than one form, in only one revolution through the sensing mechanism of the Carriage Control Unit, the life of the tape is increased.)

(6) Finally, the control tape line that matches to the bottom edge of the "last" form should be marked for cutting after the tape is punched.

(7) Punch the tape with the compact punch.

(8) After the tape is punched, it is cut and looped into a belt. The bottom end is glued to the top section marked "GLUE"! The bottom line must match up to the first line.

(Before the tape is glued, the glaze on the tape should be removed with an eraser; if this is not done, the tape ends may separate. Also, the pinfeed holes should match up when the two ends of the tape are glued together.)

11. Operator Responsibility: The computer operator has only the following responsibilities in regard to the computer printer.

a. The operator is responsible for mounting the correct type of form according to the job instructions.

b. The operator must insure that the form is properly aligned to cause printing to correctly begin at the desired first line of print.

c. The operator is responsible for mounting the correct carriage control tape as stated in the job instructions.

d. The operator performs preventive maintenance limited to cleaning the inside and outside surfaces of the printer. The operator must take precautions when cleaning the interior areas of the printer and avoid areas where electrical mechanisms and wiring are present to prevent electrical shock to himself and possible damage to the printer.

e. The operator is responsible for changing the printer ribbon when it is worn out.

f. The operator is responsible for the proper marking of security classifications, the proper handling of classified forms, and the proper disposition of all computer printouts.

E. SUMMARY: In this chapter, you learned about the characteristics of impact, and nonimpact printers, and of the computer forms that are used by impact printers. The functions of the printer carriage, and the methods of controlling paper movement through an impact printer were also discussed, and finally, operator responsibilities for printers were itemized.

F. CONCLUSION: As a computer operator it is important that you know the material in this chapter. The knowledge of this chapter will help you better understand later lessons on the computer printers and will enable you to perform your duties.

Self-Evaluation Quiz

1. The two types of printers are:

   a. Impact, line.

   b. Serial, line.

   c. Drum, chain.

   d. Golf ball, MATRIX.

   e. Impact, nonimpact.

2. Two types of line printers are:

   a. Impact, line.

   b. Serial, line.

   c. Drum, chain.

   d. Golf ball, MATRIX.

   e. Impact, nonimpact.

3. The two types of impact printers are:

   a. Impact, line.

   b. Serial, line.

   c. Drum, chain.

   d. Golf ball, MATRIX.

   e. Impact, nonimpact.

4. Two types of serial printers are:

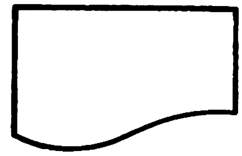
   a. Impact, line.

   b. Serial, line.

   c. Drum, chain.

   d. Golf ball, MATRIX.

   e. Impact, nonimpact.



5. Serial printers:
   a. are used for large volume printout.
   b. are normally nonimpact.
   c. may be part of an inquiry device.
   d. are normally Drum printers.
   e. are normally Chain printers.
6. The purpose of pinfeed holes on the computer form is:
   a. for the sake of efficiency.
   b. to allow the printer to move the form.
   c. to provide more than one copy of a report.
   d. only to be used on line printers.
7. The purpose of computer forms being continuous is:
   a. for the sake of efficiency.
   b. to allow the printer to move the form.
   c. to provide more than one copy of a report.
   d. only to be used on line printers.
8. The multipart forms are used:
   a. to allow the printer to move the form.
   b. to provide more than one copy of a report.
   c. only to be used on line printers.
9. The purpose of the carriage control unit:
   a. is to automatically feed the computer form through the printer.
   b. is to control the movement of the computer form.
   c. is to indicate printing positions of the computer form.

d. to insure forms are initially correct in alignment.

10. The purpose of the carriage:

    a. is to automatically feed the computer form through the printer.

    b. is to control the movement of the computer form.

    c. is to indicate printing positions of the computer form.

    d. to insure forms are initially correct in alignment.

11. The purpose of the carriage control tape:

    a. is to automatically feed the computer form through the printer.

    b. is to control the movement of the computer form.

    c. is to indicate printing positions of the computer form.

    d. to insure forms are initially correct in alignment.

12. Channel 1 on the carriage control tape:

    a. will normally represent the bottom of the computer form.

    b. will normally be used to position the form anywhere between the first and last line of print.

    c. will normally represent the first line of print on the computer form.

    d. will normally represent the second line of print.

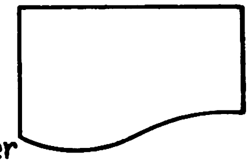
    e. will normally represent the last line of print of the computer form.

    f. will normally represent the top of the computer form.

13. Channels 2 thru 11 on the carriage control tape:

    a. will normally represent the bottom of the computer form.

    b. will normally be used to position the form anywhere between the first and last line of print.



c. will normally represent the first line of print on the computer form.

d. will normally represent the second line of print.

e. will normally represent the last line of print of the computer form.

f. will normally represent the top of the computer form.

14. Channel 12 on the carriage control tape:

a. will normally represent the bottom of the computer form.

b. will normally be used to position the form anywhere between the first and last line of print.

c. will normally represent the first line of print on the computer form.

d. will normally represent the second line of print.

e. will normally represent the last line of print of the computer form.

f. will normally represent the top of the computer form.

15. True or False. The operator is responsible for all preventive maintenance for the computer printer. ____________

16. Cartons of computer forms normally should not be stacked more than:

a. 10 high

b. 3 high

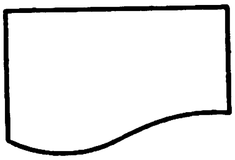
c. 6 high

d. 5 high

17. The operator is responsible for:

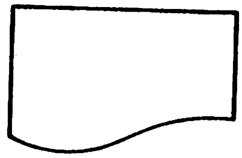
a. changing the printer ribbon.

b. cleaning of the interior and exterior surfaces of the printer.



c. changing the print mechanism.

d. labeling printed forms per run instructions.



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CHAPTER 4

Magnetic Tape Input and Output

A. INTRODUCTION: The speeds of card readers and card punches are measured in cards per minute; but some computers can process information at a rate that is measured in a millionths of a second. This tremendous difference in speed of a computer vs card input/output devices make it very inefficient to use large volume card input or output. Magnetic tape partially solves the problem of great speed differences, it can send and receive data in thousandths of a second.

Computer magnetic tape like any other recording tape has similar physical characteristics, however, computer magnetic tape requires careful handling and error free conditions. Data placed on computer magnetic tape requires a high state of accuracy so that reports that are used for making decisions are not in error (e.g. payroll allowances).

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. The physical characteristics of magnetic tape.

2. The characteristics of data recording.

3. The different type labeling characteristics.

4. A multi-volume File.

5. A multi-file Volume.

6. Care and handling requirements of magnetic tape.

C. TRAINING AIDS: None.

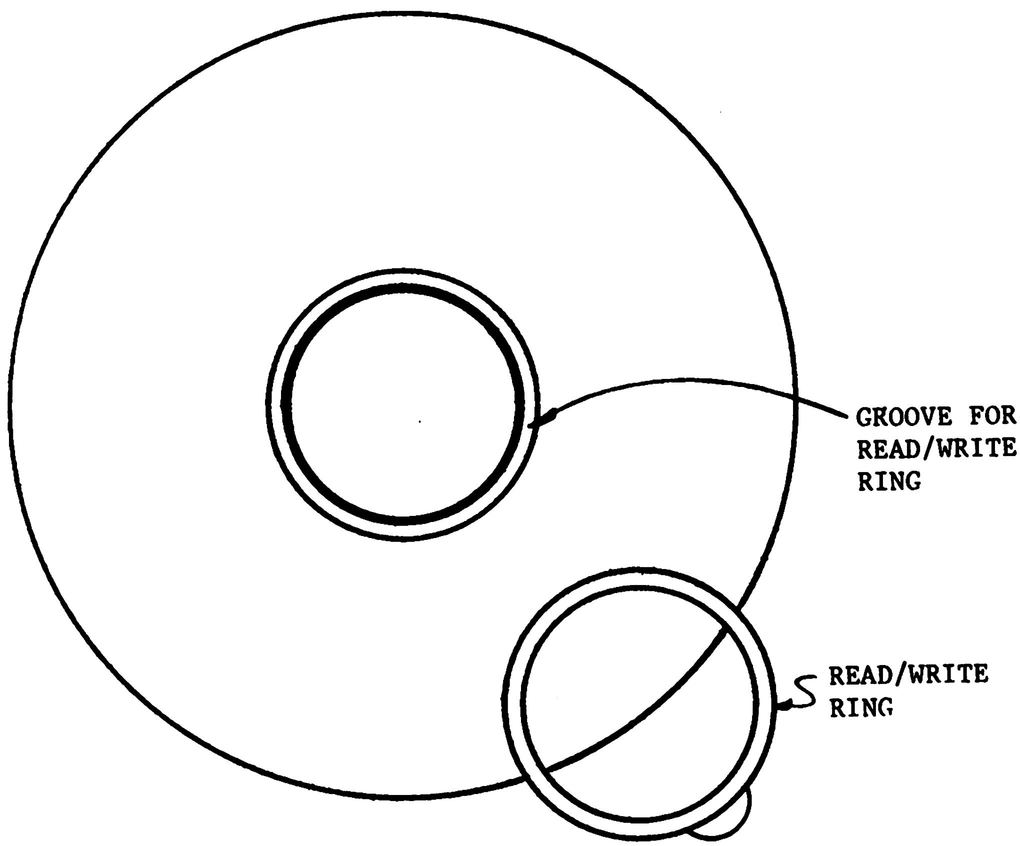
D. TRAINING: Magnetic tape provides input and output for a computer, and is written on or read by the read/write heads of an input/output device called a tape drive. As a computer operator, you will most likely be required to use magnetic tape whenever processing jobs on a computer, for this reason it is important that you become familiar with the characteristics of magnetic tape.

1. Physical Characteristics: Computer magnetic tape is most commonly placed on tape reels.

a. Once magnetic tape is manufactured, it is wound on plastic reels. Generally speaking, a full reel of tape will contain about 2400 feet of magnetic tape, but smaller reels with as little as 50 feet of tape can be purchased.

b. Write Ring: One characteristic of magnetic tape is that it is reusable. Once data on magnetic tape is no longer needed, new data can be "written over" the old data. A plastic Write Ring is provided by the tape manufactures to allow the computer system to write new information on a magnetic tape. The write ring must be placed in the groove on the back of the reel to allow the tape drive, which reads and writes the data, to write on the tape. Because the writing operation destroys any previous data on the tape, it is necessary to remove the write ring if the data is to be saved. If the write ring is removed, no recording can take place and the data is protected against any accidental writing which could erase valuable data. A good statement to remember as a self-promoter when using the ring is "no-ring - no write." A tape that contains no data or old data that may be written over is called a scratch tape. Scratch tapes are used as output tapes for the recording of new data which can be saved for input at a later time. After the data is no longer needed, the tape becomes a scratch tape again and the cycle is continued (See Illustration #1).

Illustration #1



c. Reflective Markers: Reflective markers allow the tape drive to sense where usable tape begins and ends on the tape reel.

The first marker is called a beginning of tape marker (BOT). It is a silver reflector 1 inch by 3/16 inch located 10 feet from the beginning of the tape and must not be more than 1/32" from the edge of the tape. when the tape is mounted on the tape drive this reflector must be facing toward the operator. By using a photo-electric cell, the tape drive senses this reflector as the beginning of usable tape where it will begin reading or writing information depending on the operation immediatly following this point. The 10 feet of leader before the BOT is used for threading the tape on the tape drive. this 10 feet of tape is the only portion of that tape an operator is allowed to touch with his hands. Touching any other part of the tape can cause contaminates such as fingerprints and dirt to contact the recording surface where data is written.

The second marker is the end of tape marker (EOT) located 14 feet from the end of the tape. This marker is located on the furthest edge from the operator when the tape is mounted on the tape drive, and also must not be more than 1/32" from the edge of the tape. By locating the marker on opposite sides of the tape, the tape drive will know whether it is at the beginning or end of the tape (again by the use of a photo-electric cell). The 14 feet located at the end of the tape has one additional purpose beside protection from contaminates, it allows the tape drive to write a trailer label* after it senses the EOT marker (See Illustration #2).

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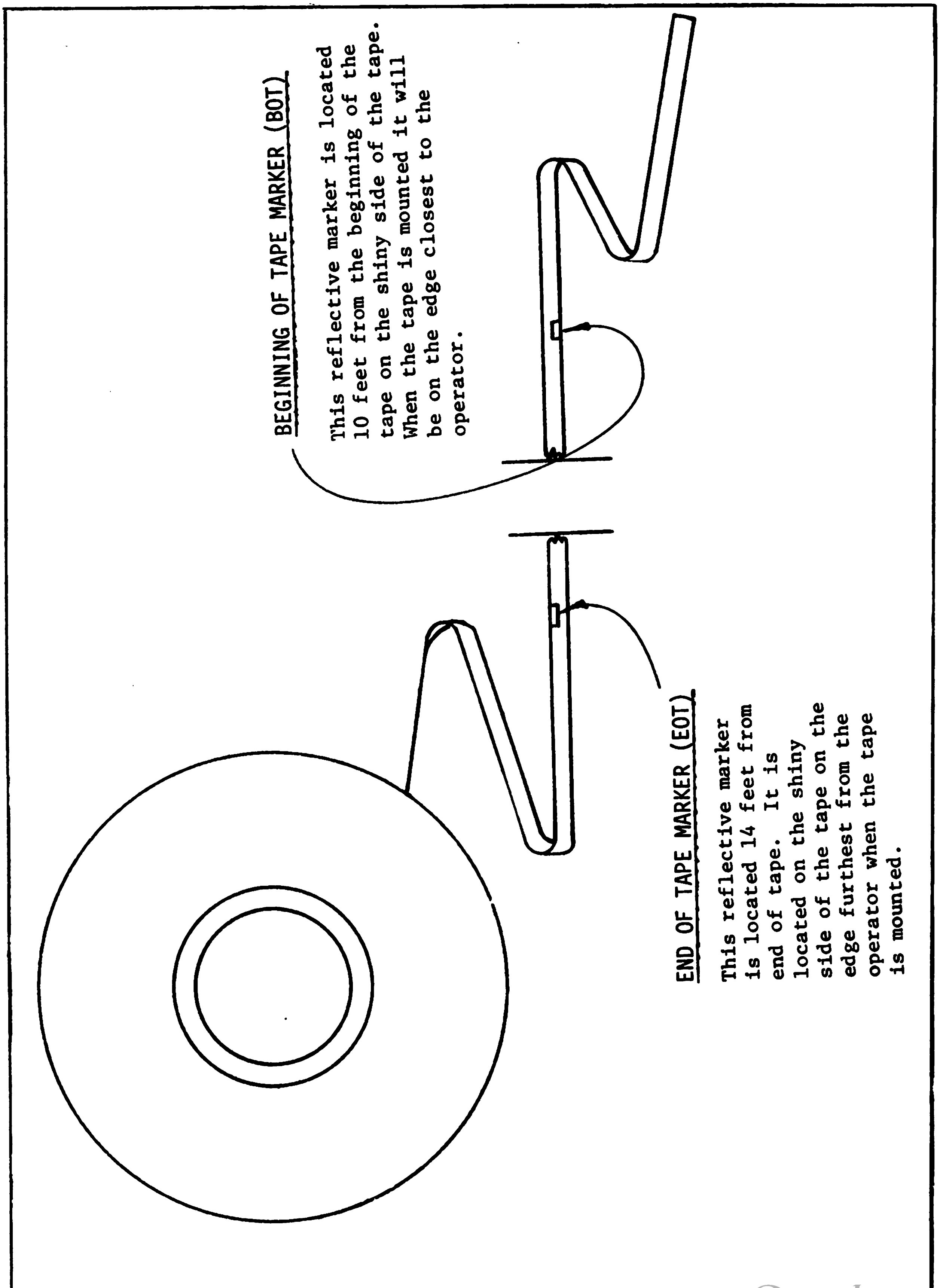
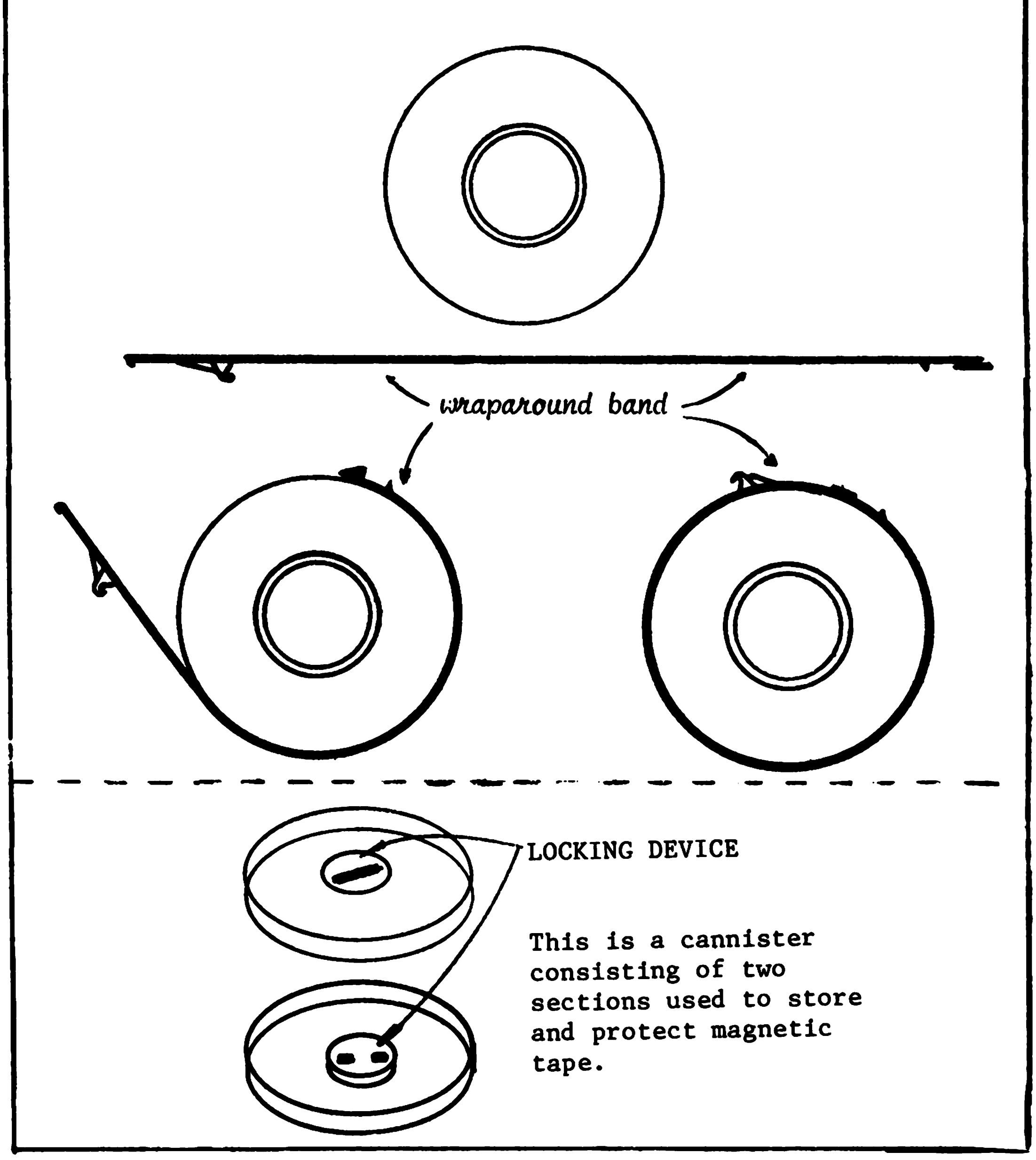
* A trailer label contains control information, about a file, that is used by the computer system.

Illustration #2



d. Wraparound Band: A reel of tape must be protected at all times. The wraparound band protects the tape on the reel and the reel itself. The wraparound band prevents contaminates from contacting the tape surface and also prevents the reel from warpage. The wraparound band is a thick plastic strip that is wrapped around the tape and connected by a simple plastic locking device. Some installations protect tape by storing them in a plastic container called a canister. This canister will completely incase the magnetic tape (See Illustration #3).

Illustration #3



2. Recording Characteristics: Data on magnetic tape is represented by magnetic spots. Each alphabetic, numeric and special character, that is recognized by the system, will have its own unique arrangement of magnetic spots that will represent it. This section will inform you how a computer system will use these magnetic spots to represent and control data.

a. Represent data: The type of computer system a DPA has will determine the amount and combination of magnetic spots that will be used to represent each character. The type this chapter is concerned with is the Extended Binary - Coded Decimal Interchange Code (EBCDIC). "EBCDIC" uses a combination of 8 positions, where a position may contain a magnetized spot or may be left blank, to represent a character. In data processing each magnetic spot position is referred to as a "BIT", resulting in that there are 8 bits to a character. Also a term used to refer to these 8 bits is "Byte". These two terms will actually become part of your everyday vocabulary. All you really have to remember is that there are 8 bits to a byte. Similar to the hollerith code "EBCDIC" represents characters in columns. Each character is represented by its own unique arrangment of magnetized and unmagnetized bit positions. Bit positions along the length of the tape are called tracks. (See Illustration #4).

Illustration #4

Represented Characters

MAGNETIC TAPE	0	1	2	3	A	B	C	&	*	$	8 BITS TO A BYTE
	0	0	0	0	0	0	0	0	1	1	
	0	0	1	1	0	1	1	0	0	1	
	1	1	1	1	1	1	1	0	0	0	
	1	1	1	1	1	1	1	1	1	1	
	1	1	1	1	0	0	0	0	0	0	
	1	1	1	1	0	0	0	1	1	1	
	0	1	0	1	1	0	1	0	0	1	
	0	0	0	0	0	0	0	0	1	0	

1 = magnetized bit
0 = unmagnetized bit

b. Insure data is correct: A computer system cannot insure that data placed on a tape is the data required by the installation, but it can insure that data is actually represented by the correct bit combination. This is done by the use of read/write heads, and another bit called a parity bit.

(1) Read/Write heads: As previously mentioned, tape drives of a computer system are equipped with read/write heads. When a tape drive is given instructions to write a character on magnetic tape, the tape drive will write the combination of bits that represent that character. Then it will immediatly check the bit configuration with the read portion of the head to verify that is actually wrote the bit configuration intended.

(2) Parity bit: The above mentioned procedure is used when creating output tapes. However, when a tape with data is used as input, the immediate self-checking method cannot be used. This problem is resolved by the use of an extra bit called a "Parity Bit". This parity bit is not used in representing a charater. Its purpose is to insure that the number of magnetized bits in each byte are either odd or even, depending upon the computer system used. (See Illustration #5).

Once the tape has been created and is used as input, the tape drive will check to see if there are odd/even number of magnetized bits before it even attempts to send the information to the computer. If the number of magnetized bits meet the parity requirement, the tape drive will continue reading additional information. If the magnetized bit number requirement is not met, a parity error exists and the tape drive will stop reading the information. At this time the computer will issue a message to the operator indicating a parity error condition. This parity error is sometimes referred to as a parity check or data check.

(a) Odd parity: At the time the tape is being created (written on), the computer system will identify how many magnetized bits are required to represent the desired character. If the computer system uses odd parity and the magnetized bits are odd in number, the tape drive will not magnetize the parity bit. It just places the required bit combination on the tape. If the magnetized bits are even in number, the tape drive will magnetize (in a predetermined bit position) the parity bit on the tape. This magnetized parity bit, in addition to the proper bit configuration, makes the total number of magnetized bits odd in number. The example shown in illustration #5 is odd parity.

(b) Even Parity: If the computer system uses even parity, the tape drive does just the opposite of the procedure for odd parity.

Illustration #5

		0	1	2	3	A	B	C	&	*	$	
M		0	0	0	0	0	0	0	0	1	1	
A		0	0	1	1	0	1	1	0	0	1	
G	T	1	1	1	1	1	1	1	0	0	0	
N	A	1	1	1	1	1	1	1	1	1	1	
E	P	1	1	1	1	0	0	0	0	0	0	
T	E	1	0	0	1	0	0	1	1	1	0	← PARITY BIT POSITION
I		1	1	1	1	0	0	0	1	1	1	
C		0	1	0	1	1	0	1	0	0	1	
		0	0	0	0	0	0	0	0	1	0	

(c) Tracks: The particular tape that we are discussing in this chapter has 9 bit positions (one is for Parity, 8 is for the Byte). The tape drive that reads/writes on the tape is a 9 track tape unit. Other types of tape drives use only 6 Bits to represent a character plus the parity bit. This type of tape drive is called a 7 track tape unit. As an operator, you need to know that a 7 track tape unit can't read a 9 track tape and visa versa.

(d) Tape Density: The density, of a tape, is determined by the amount of information it can hold in a given length of tape, normally one inch. The abbreviation BPI* is used to state the density of a tape or tape unit. BPI can also reflect the amount of characters that can be stored on an inch of tape. The most common BPI's in the Army are 800 and 1600. A tape unit can only read those tapes which have the same density as it has.

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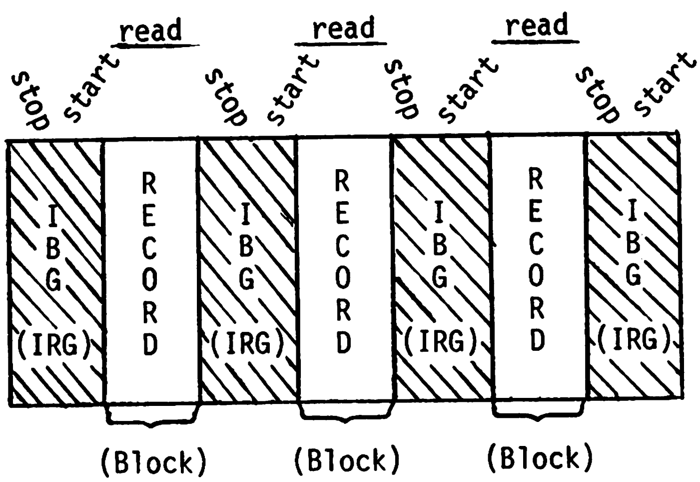
* BPI can stand for Bits-Per-inch or Bytes-Per-Inch. Bits-Per-Inch is the number of Bits that can be stored side by side along one track in an inch. Bytes-Per-Inch is the number of Bytes that can be stored in an Inch.

(e) Gaps: Recording data properly on tape is very important. Tape drives must perform reading or writing on a tape at a constant rate of speed. A tape unit that fails to do this results in reading or writing too few or too many magnetized bits and and error may occur. Inter-Block-Gaps (IBG) assist in insuring that the timing is accurate. An IBG is a blank space on a magnetic tape between each block if information. This IBG allows the tape drive to reach its constant rate of speed for writing or reading and slow down to a stop.

BLOCK: A block consists of one or more records* that are read or written at the same time. When a block contains only one (1) record, the gap is sometimes referred to as an Inter-Record-Gap (IRG) (See Illustration #6).

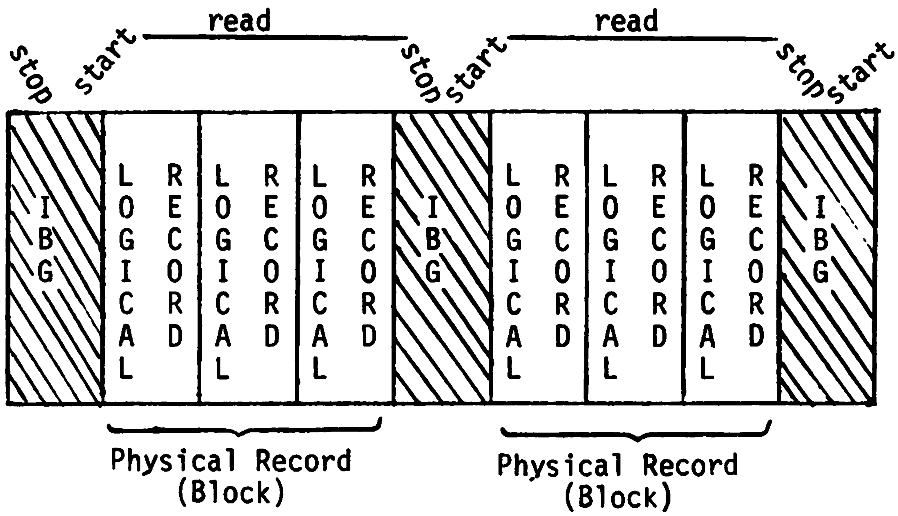
Illustration #6



* RECORD - A group of one or more facts on a related subject such as an employee's payroll record.

BLOCKING: Repetitive staring and stopping of a tape drive takes valuable computer system time. One way that a DPA can increase computer productivity is to group records together into a block. This lowers the number of gaps and inturn enables the tape drive to send more information to the computer between starts and stops. In addition to reducing input/output time, the consolidation of records into blocks provides more space for data, and fewer gaps (See Illustration #7).

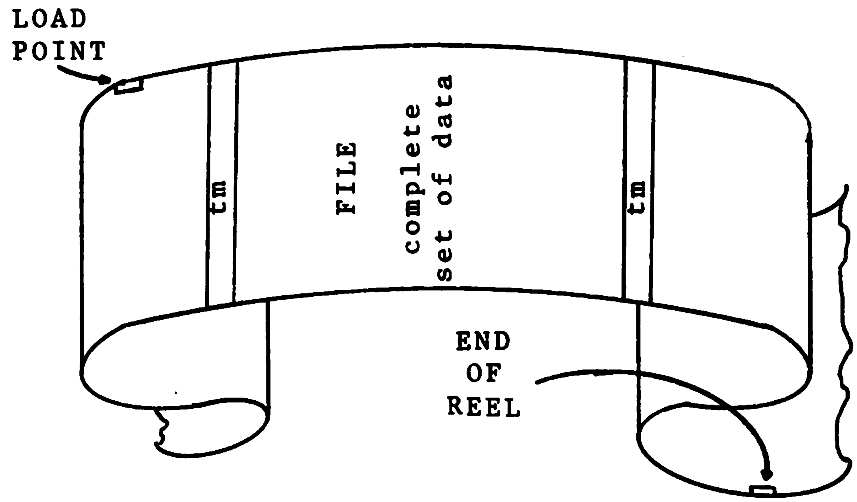
Illustration #7



In illustration #7 you notice two new terms, logical and Physical record. A logical record is a record contained within a block, and a block is referred to as a physical record.

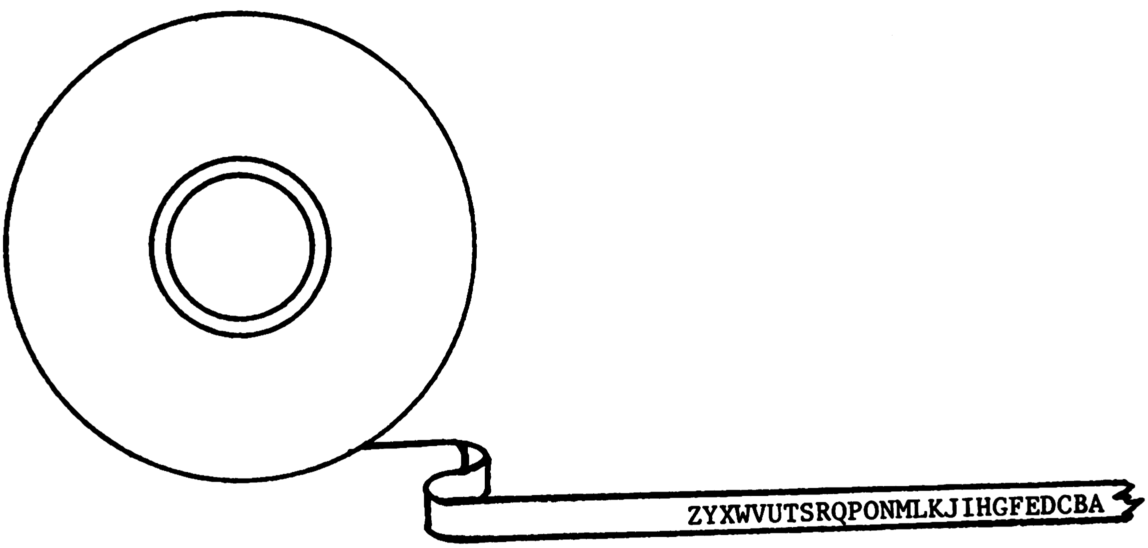
(f) Tape file: The definition of a file is. A group of related records. An example of this is a personnel file where all the records on that file contain personnel data. When creating a tape file the computer system will place a special character (one that is used by the system for control purposes) at the beginning of the file and at the end of the file. This special character is commonly referred as a tape mark (See Illustration #8).

Illustration #8



(h) Sequential: The physical characteristics of magnetic tape makes it sequential in nature. This means, the information on the tape is read/written in a one after the other sequence. To illustrate this let's say the computer system is instructed to see if PVT ZAP's personnel record is on the personnel file. If the records are in alphabetical order the tape drive would have to first read all personnel on that tape with last names starting with A through Y before it can read Pvt Zap's record (See Illustration #9).

Illustration #9



Magnetic tape files are sequential files

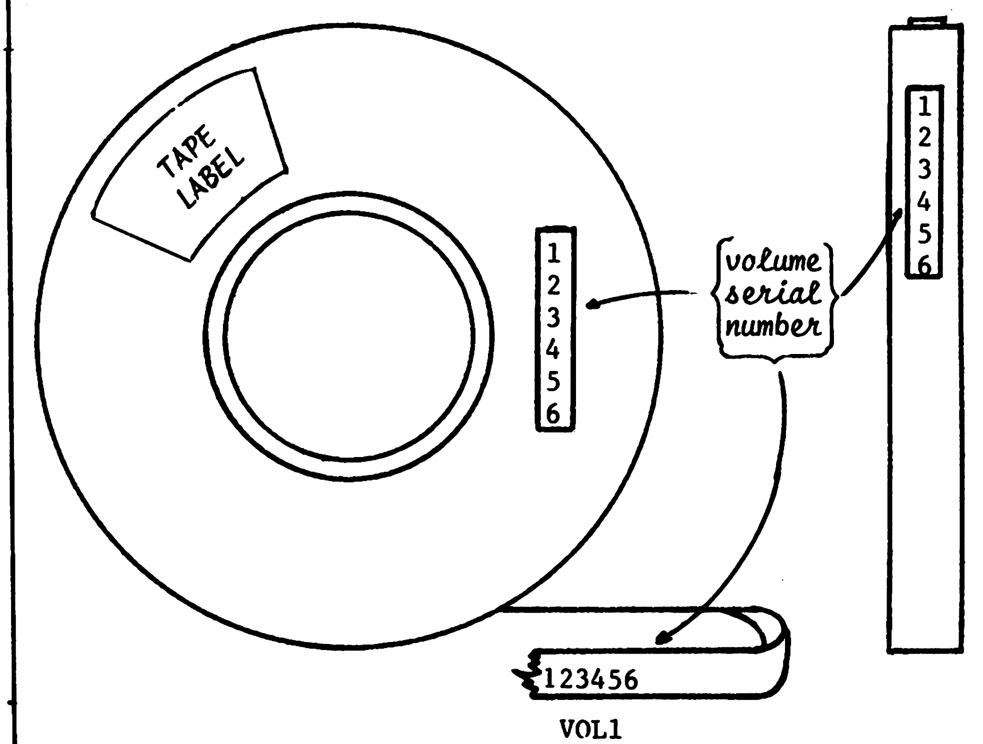
3. Labeling: Data processing Activities that use magnetic tape as a form of input and output normally have a tape library. This library may consist of hundreds of tape reels. Tape labeling provides a way of identifying each tape. Basically speaking, magnetic tape has two types of labels, they are external and internal.

a. External labels: The computer operator can identify a magnetic tape reel by a volume serial number label, and can identify value information about the contents of the tape reel (volume) by the use of another external tape label.

(1) Volume Serial Number: Each tape volume will have assigned to it a unique (permanent) 6 digit Alphamumeric* serial numnber which will identify it from all other tapes in the tape library. This volume serial number will be placed on the exterior of the tape, and will remain on the tape throughout its life.

(2) Tape label: When a tape has current (valid) data that is required by the DPA, it will have an external label informing the DPA personnel of the contents of the tape, and when the tape can be released (scratched) to have new information written on it by the computer system (See Illustration #10).

Illustration #10



*Alphanumeric is a term used whenever referring to both alphabetic and numeric characters.

b. Internal labels: The purpose of internal labels is to allow the computer system to verify if it has the correct input tape, or to verify that the output tape that it is going to write on is the correct one, and that it is truly a scratch tape (See Illustration #11).

(1) Vol 1: The Volume 1 label is the first record on the tape. It informs the computer as to the volume serial number of that tape. On input tapes, the computer will check to see if the Vol 1 label agrees with its instructions. If it doesn't agree, the system will issue a message to the operator that the correct tape is not available for processing. If the tape is an output tape, the computer will verify that the tape has a volume serial number. If it doesn't have a serial number the computer will issue a message indicating that the operator must enter the volume serial number of that tape so that the system can write that number on the tape.

(2) HDR 1: The header 1 record has two primary purposes, they are; for the computer to verify that the correct input file is being used and to insure that if that tape is being used as output that the already existing file is expired.

. On an input tape the system will verify that the Data-Set-Name * is in agreement with the computer instructions, before using the tape file as input. If the computer instructions differ from the data-set-name, a message will be issued to the operator that a disagreement exists.

. On an output tape, the system will check the expiration date ** in the header 1 label to insure that the file is a scratched file before writing over the information. If the file has not expired, the computer will issue a message indicating that the tape is unexpired.

(3) Trailer label: The trailer label of a standard labeled tape can serve one of two purposes, it can indicate that the end of file (EOF) has been reached, or it can indicate that the end of volume (EOV) has been reached.

* Data-Set-Name is the name written in the header label of a file and is used for verification purposes.

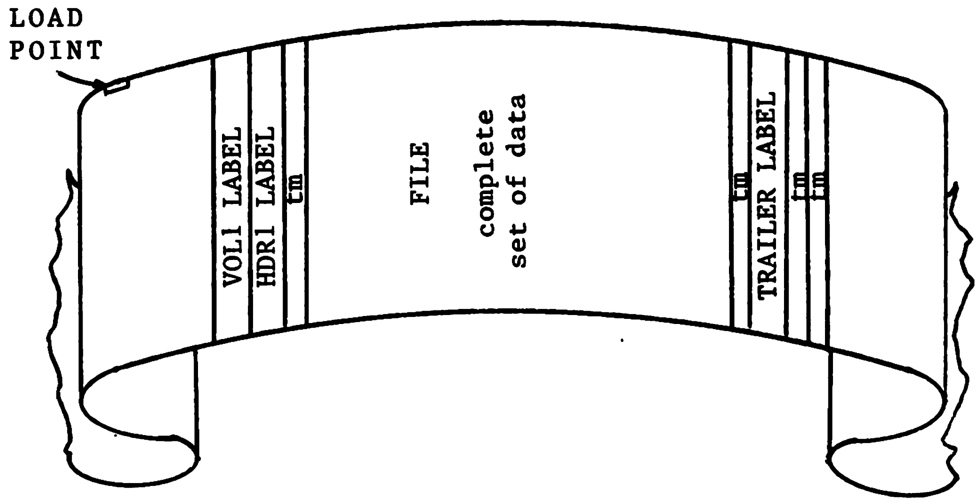
** At the time a file is created, the computer will write a file expiration date in accordance with instructions.

. EOF: The "end-of-file" trailer label immediately follows the file (complete set of data). It basically has the same type of information that the header label has with the exception that it has a Record Count Field. When a file is used as input, the computer system will keep track of the amount of records (Blocks) that it read, it will compare the amount of records read to the amount written in the block count field. If there is disagreement in count, the computer will issue a message to the operator indicating that an error exists.

. EOV: The "end-of-volume" trailer label has the same information as the EOF trailer label. The EOV trailer label will be used whenever more than one tape volume is required to hold the file. Only the last tape will have an EOF trailer label, all other tapes prior to the last tape will have an EOV trailer label. The EOV trailer label will indicate to the system that at least one more tape is required to complete the file.

The block count field of the EOV trailer label contains only the number of records (blocks) which are written on that tape volume. The EOF trailer label which is written at the end of the file contains only the number of records written on the last tape volume.

Illustration #11



4. Multi-volume File: A multi-volume file is a file which requires more than one reel of tape. A computer may be working on a file which has more data records than can be held on one tape. This file would be called a multi-volume file in that it takes <u>more than one tape</u> to hold that file.

5. Multi-file Volume: A Multi-file Volume is a tape reel which has more than one file on it. A DPA may have a number of small files that are needed for processing a job. In data processing two main concerns are space and speed. The activity may place those small files on one magnetic tape volume.

6. Care and Handling of Magnetic Tape: The recording and reading of magnetic tape is highly dependent upon the care and handling of the tape. A particle of dust between the Read/Write heads can cause errors. It is one of the operator's responsibilities to insure that the tape drive is cleaned at proper intervals. Remember the following rules when handling magnetic tape:

a. Do not pinch tape reel flanges. This could damage the tape and, in turn, lose or cause data to be misread.

b. Keep the tape storage area free of all dust, including paper-form dust. This will reduce the possibility of contaminating tape. Because of the close tolerance discussed, a speck of dust can cause read or recording errors and cause the tape to be scratched or damage the read/write head.

c. All labels must be of a nonshedding material, otherwise, dust and dirt may be generated causing errors or damage as discussed in b. above.

d. If tape reel canisters are used, keep reel canister cover closed, even when the tape reel has been removed. The canister in which the tape is stored should be the cleanest area in the computer room. The canister should not be opened outside the clean room environment.

e. Do not use clear cellophane tape to affix anything to the reels or tape. The gummy adhesive can work loose and stick to the tape surface causing damage and, consequently, errors.

f. Destroy damaged reels, do not use them as take-up reels. A broken or badly distorted reel can quickly damage a tape edge, making the tape useless, and the debris generated from nicked tape can be held in the machine and contaminate other areas.

g. Never touch the tape beyond the load marker; information is recorded from this point on. Fingerprints create deposits of oil and salt which are excellent holding areas for dust and lint which contaminates the reel of tape.

h. Handle tape reels by the hubs. The hub is the strongest part of the reel and will not pinch the tape.

i. Clean tape flanges frequently when reel bands or tape seals are used in place of reel cases.

j. Clean dust covers periodically to assure the canister is the cleanest item in the computer room. Use a lint free cloth dampened with an approved cleaner.

k. Do not use a reel of tape that has been dropped. Damage could have occurred to the tape and the tape should be carefully inspected prior to use.

l. Maintain recommended temperature and humidity control for tape. The smaller the environmental change experienced by the tape, the better the operation and reliability.

Tape will expand and/or contract with significant temperature change. This expansion/contraction effects the relative position of bits of data prerecorded on tape. Reading and writing under such variation of temperature will cause data errors.

m. Keep tops of tape drives free of all articles. Accidents do happen and residue or debris can cause damage to the tape unit or to the tape.

n. Never use an eraser on a gum label that is attached to the tape reel. Again, erasure particles can adhere to the tape surface causing read and write errors.

o. Periodically, snip damaged ends of tape on scratch reels and relocate load point marker if necessary.

p. Keep tape reels from coming in contact with clothing, as particles of dust and lint can be picked up.

q. Maintain accurate tape usage logs. Accurate logs will enable usage analysis in order to schedule tape inspection and cleaning. Your installation will have a tape cleaning machine for this purpose.

r. Do not store tape reels near transformers or other electronic type equipment. Any magnetic omissions can rearrange data on the tape. In addition, excess heat can cause unwanted expansion in the tape. In many ways, careful tape handling is common sense. Attention to good handling procedures will significantly reduce the possibility of tape damage or lost data because of operator carelessness.

E. Summary: In this chapter you were introduced to magnetic tape, and how a computer system can write data on that tape. Recording on a magnetic tape is accomplished by the use of bits, and a parity bit is used to insure that the data on magnetic tape is as accurate as possible. Magnetic tape has internal and external labels to identify tape volumes, and the contents of those volumes. A multi-volume file is a file which is too large for one tape, and a multi-file volume is a tape volume with more than one file. Finally, you were taught about the care and handling of magnetic tapes.

F. CONCLUSION: As a future operator, it is very important to know the characteristics of magnetic tape in that this knowledge will help you to interpret error conditions when running a job on a computer system. At this time if you have problems with your end of chapter quiz, re-read this chapter. This chapter will definitely help you in the next chapter on magnetic disk.

SELF EVALUATION QUIZ

1. What is the purpose of the beginning of tape (BOT) and the end of tape (EOT) markers?

   a. They protect the tape from contaiminates.

   b. They tell the tape drive where usable tape begins and ends on the reel.

   c. They tell the tape drive to write standard labels.

   d. They tell the tape drive to write more than on file on the tape.

2. The write ring:

   a. allows the computer system to write new information on a magnetic tape.

   b. allows the computer system to only read information from a magnetic tape.

   c. when used on a magnetic tape, it allows the computer to only write information on a magnetic tape.

   d. when used on a magnetic tape, it allows the computer to only read information from a magnetic tape.

3. What is a multi-volume file?

   a. a volume containing one file.

   b. a complete file that is recorded on more than one volume.

   c. a volume containing more than one file.

4. What is a magnetic tape file?

   a. random file

   b. internal file

   c. sequential file

   d. direct file

5. The parity bit is used to:

a. check to insure blocks of records are not lost during the reading of a file on tape.

b. insure a column on magnetic tape is not in error.

c. save time.

d. increase speed during the reading and writing operation.

6. A scratch tape is:

a. a tape that has been marked and labeled as an input tape.

b. a tape marked for a specific purpose.

c. a tape that contains no data or old data that may be written over and destroyed.

d. a tape that contains data for historical purposes and may never be used again.

7. The three internal labels on a standard labeled tape are:

a. VOL1, LOV1 and BE1

b. HDR1, DUR1 and FUG1

c. VOL1, HDR1 and either EOF1 or EOV1

d. MK1, HDR1, LOV1

8. BPI can stand for:

a. Blanks Per Inch

b. Bits Per Inch

c. Begin Parity Inch

d. Bytes Per Inch

9. What is a multi-file volume?

   a. a file containing a record.

   b. a file written on one reel of tape.

   c. a file too large to be recorded on one volume.

   d. a volume containing more than one file.

10. A bit is:

   a. made up of 8 bytes.

   b. a magnetic spot position on a tape.

   c. a term used to describe 8 magnetic spot positions that represent a character.

   d. the indicator for beginning of tape.

11. A tape MARK:

   a. is used to mark a tape for future use.

   b. is a special character that will identify the contents of a tape file.

   c. is a special character that is used by the system for control purposes.

   d. is a reflector spot that will indicate beginning and end of usable tape.

12. True or False — Magnetic tape may be written over again and again. ______________

13. True or False — Data can be stored on magnetic tape in a fraction of the space required to store it on punch cards.

____

14. True or False — Recording on magnetic tape must be extremely accurate. Any error can cause a problem. ______________

15. True or False — Magnetic tape is used for the reasons of space and speed.

16. True or False — The wraparound band is used to protect punch cards.

17. True or False — Density refers to the amount of information that can be stored on a given length of tape. ____________

18. True or False — Groups of records on magnetic tape are called blocks of records, or physical records. ____________

19. True or False — Tape reels containing files have internal and external labels.

____

20. True or False — The Volume 1 label is the permanent identification of the tape when standard labels are used.

____

21. True or False — The header 1 label is used to identify the contents of the tape.

____

22. True or False — A logical record is a record contained within a physical record.

____

NOTES

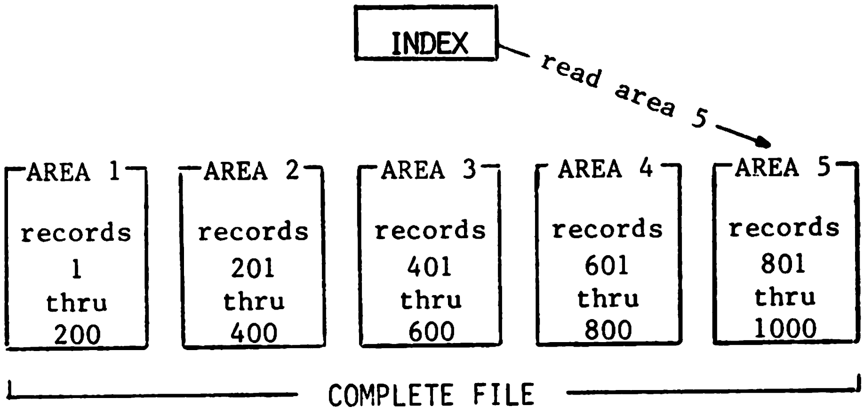
CHAPTER 5

MAGNETIC DISK INPUT AND OUTPUT

A. INTRODUCTION: The sequential nature of magnetic tape can be a disadvantage when only a few records, in a large file, are required for processing. To illustrate this, suppose a personnel job requires the 901st record on a particular magnetic tape file for processing. The computer system will have to read pass the first 900 records to get to the 901st record. This passing of the unnecessary records to get the one required record causes the loss of valuable computer time.

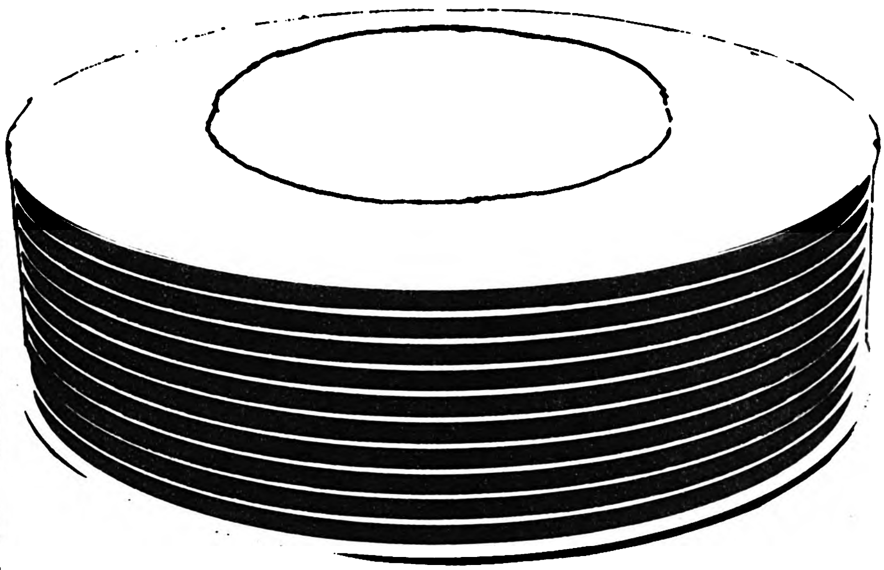
An input/output magnetic media, which has a high transfer rate , that offers a solution to this problem is magnetic disk. Magnetic disk divides a file into smaller data areas and uses indexes to determine the contents of these areas (see Illustration #1). Once the data area that contains the required record has been identified; the computer system will sequentially (serially) search that data area until the needed record has been read. This method of going directly to a particular area where a record is located is called "direct access".

Illustration #1



There are many types of direct access storage media and devices, however, the idea of direct access applies to all of them. This chapter will be training you on one particular type and style (see illustration #2).

Illustration #2



B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. The physical characteristics of magnetic disk.

2. The addressing characteristics of magnetic disk.

3. Labels of a disk pack.

4. File organization on a disk pack.

5. A method of accessing a record/records.

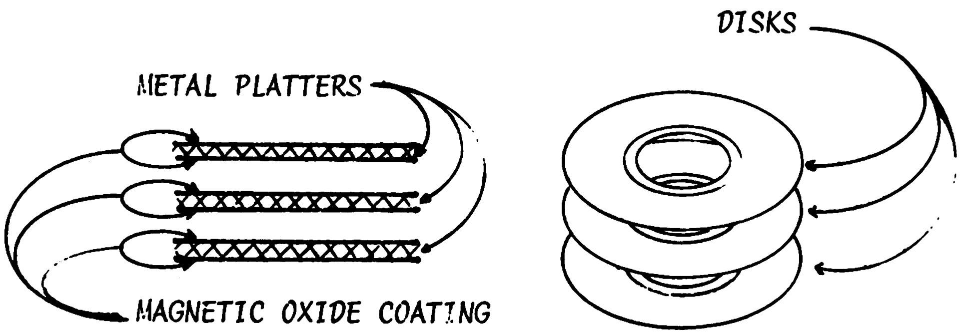
6. Conditions which effect the recording capabilities of magnetic disk.

C. TRAINING AIDS: None.

D. TRAINING: Information is written on and read from magnetic disk by an input/output device called a disk drive. As a computer system operator, you will very likely run numerous jobs that require the use of magnetic disk. For this reason, it is imperative that you become familiar with the characteristics of magnetic disk.

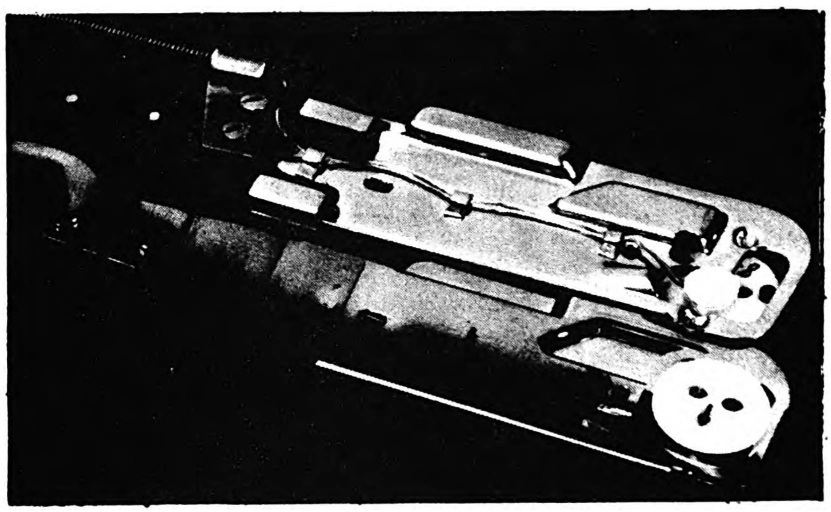
1. Physical Characteristics: A magnetic disk pack is made up of several record-shaped disks (metal platters) which are coated on the top and bottom with a magnetic oxide similar to the oxide that is used by magnetic tape. This oxide coating is where data is recorded (see illustration #3).

Illustration #3



These disks are held together, by a central drive shaft which create a "disk pack." The disk pack is mounted on a disk drive where it will rotate at a constant high rate of speed. The disk drive has a series of read/write heads (see illustration #4) that are attached to an access arm.

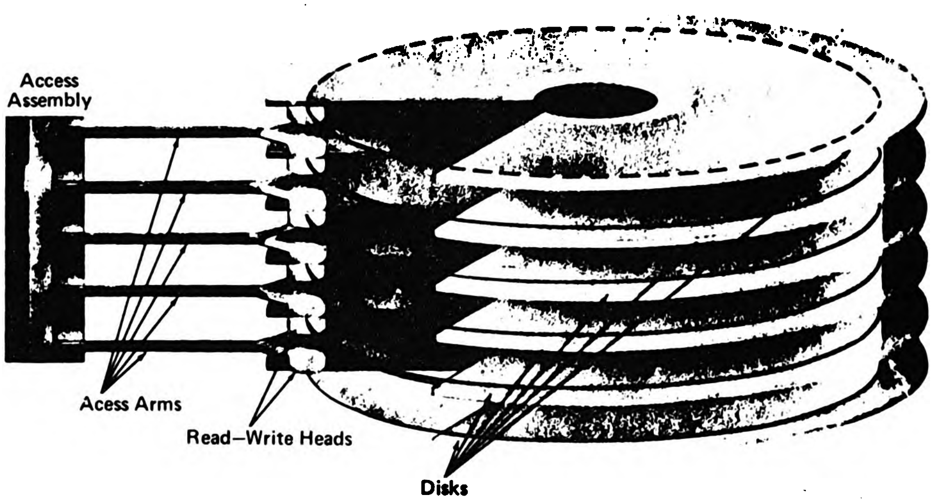
Illustration #4



This photograph shows the read/write heads mounted on an arm. An upper arm and a lower arm are shown. This arrangement would be used on a disk drive with the upper head positioned over the upper disk surface and the lower arm opposite the lower disk surface.

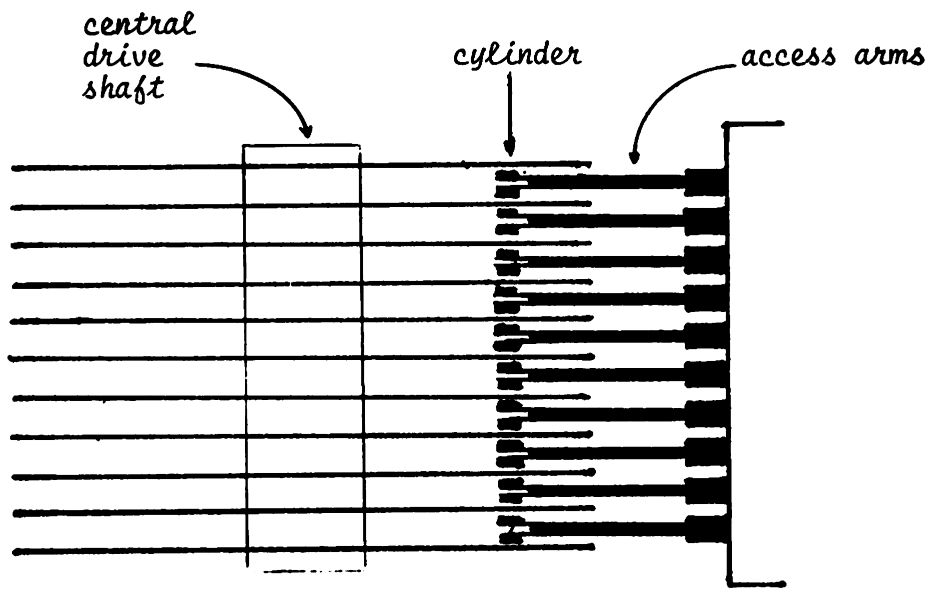
This access arm moves all the read/write heads in and out along the surfaces of the disks at one time. Each surface that has a read/write head is called a recording surface. The top of the first disk platter and the bottom of the last platter are used for protection of the pack (see Illustration #5).

Illustration #5



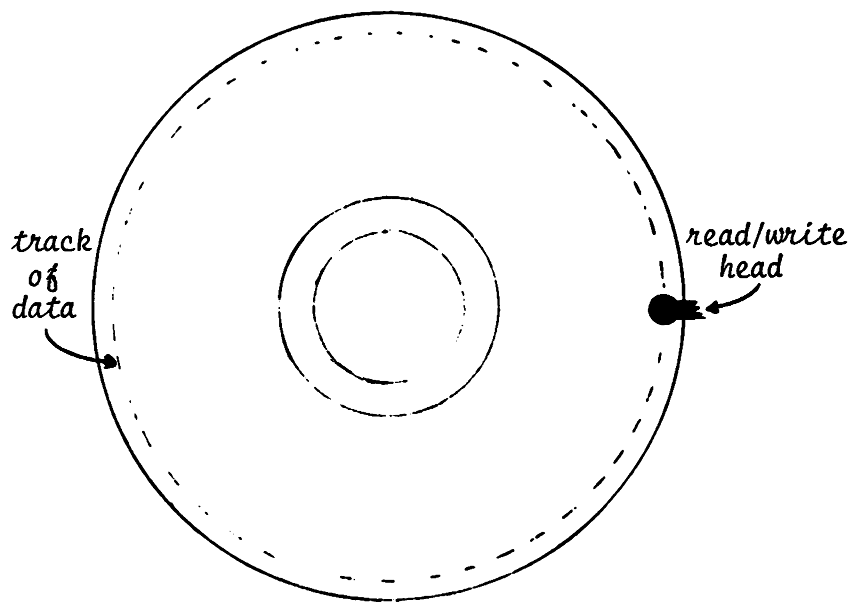
a. Cylinder: The term cylinder is used to describe a specific location of the read/write heads on the recording surfaces of a disk pack. The previous paragraph stated that the access arm can move the read/write heads in and out along the surfaces of the disks. One particular type of disk drive has 203 positions that the access arm can move the read/write heads. As a result, the disk pack that the disk drive reads or writes on will have 203 cylinders (see Illustration #6). Reading or writing is not done while the access arm is moving the read/write heads. The read/write function will only take place once the heads are positioned at the desired cylinder.

Illustration #6



b. Track: When data is recorded on the surface of a disk platter, while it is rotating, it creates a circular pattern. The term track is used to describe the circular path (one bit wide) of data that one read/write head will create around the recording surface of a disk at one location (see Illustration #7). Each cylinder (read/write heads position) will have as many tracks as there are read/heads on the access arm. The particular model this chapter has been discussing has 20 read/write heads attached to the access arm, as a result each cylinder will have 20 tracks.

Illustration #7



2. Addressing Characteristics: The particular disk pack example that is being used in this chapter has 203 cylinders. By numbering the 203 positions (cylinders) the access arm can move the read/write heads and by numbering each read/write head, a specific address can be given to a track. This is accomplished by the first cylinder being given the number of 000, the second cylinder 001, and so on until the 203rd cylinder is given the address of 202 the read/write heads are numbered 00 thru 19. As a result, an address of 100-19 can represent the 101st cylinder and the 20th track of that cylinder. This addressing technique allows the computer system to use the direct access method.

Normally when a disk drive is having trouble reading or writing information on a track it will display a message using this addressing method to specify that track. Whenever a message like this occurs, the operator should report this situation to the shift supervisor so that action may be taken to prevent a computer malfunction.

3. Labels of a Disk Pack: Each new disk pack received by a Data Processing Activity (DPA) must be initialized to make it usable by the computer system. This initialization will assign an alternate track address for any tracks found to be marginal (cannot easily be written to or read), assign a unique volume serial number to the disk pack, and finally create a special area for the Volume Table of Contents.

a. Alternate Track Assignment: As stated earlier the type of disk pack discussed in this chapter has 203 cylinders. Two-hundred cylinders are used for storage of information, and 3 cylinders are used for alternate track assignments. After a disk pack is manufactured, each track on every cylinder is tested. The base of the disk pack container (dust cover) will contain a Quality Control Sticker that will list each track that was found to be marginal (See Illustration #8). The DPA will use this information when initializing the disk pack for alternate track assignments. This procedure will eliminate any problems that may be experienced with faulty tracks.

b. Volume Serial Number: During the time of initialization, the disk pack will be assigned a unique volume serial number for identification purposes, also contained in the volume serial number record is the cylinder and track address of the Volume Table of Contents of that disk pack.

c. Volume Table of Contents: The volume Table of Contents (VTOC) is the area that will contain the information about each file that resides on the disk pack (there may be several files on the disk pack). In the VTOC will be the Data-Set-Name, the creation and expiration date, and the area of the disk pack each file resides. The VTOC will also contain the area where an index for each cylinder of each file that resides on the disk pack.

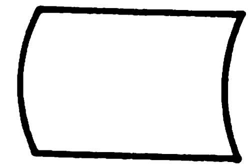
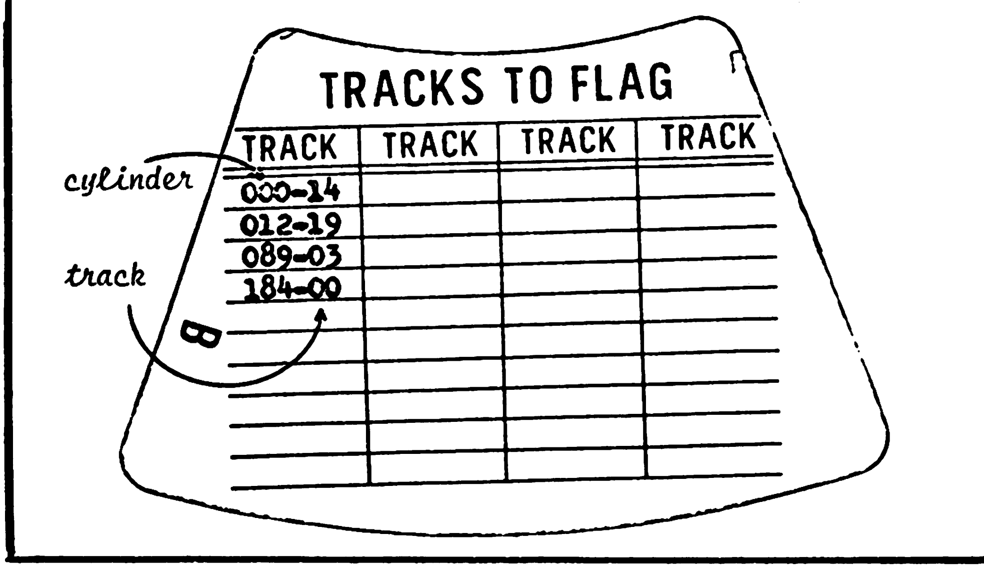


Illustration #8



4. File Organization: Magnetic disk is called a direct access media because a file or a record can be immediatly accessed instead of reading each record preceeding the required record. While tape files are in some type of sequence, disk files can be organized in several different ways. There are three basic file organization methods for disk, they are: sequential, direct access, and index sequential.

a. Sequential: This type of file would be organized in the same manner as a file on tape. Quite often at a DPA, small sequential files will be placed on disk but larger ones will be written on tape. Records in a sequential file will be written one after the other track after track, cylinder after cylinder.

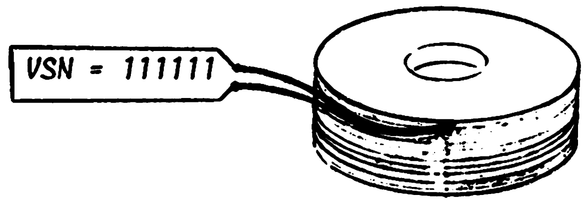
b. Direct Access: With this type of file a control field in a record called a key is mathematically manipulated into an actual cylinder and track address. After the key is converted to an actual address the disk drive can position the access arm at the location and read or write the record.

c. Index Sequential: When an index sequential file is created on disk it is sequentially divided into different segments. Also, a series ofindexes are created containing the address of each segment, and information about the records contained in each segment. This type of file organization will be covered in the next section of this chapter.

5. Accessing a Record: Once a file has been created on a disk pack, the system can retrieve any record on that file by the use of indexes. To illustrate this let's use one indexing method with the original example of requiring only the 901st record of a file. Instructions will be given to the computer system to retreive that record from a particular file that resides on a specific disk pack. The steps may take place as follows:

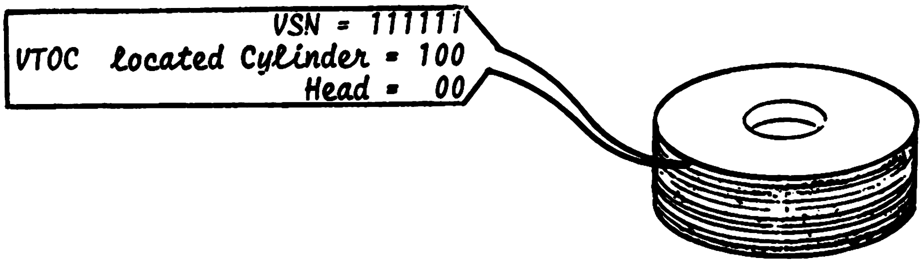
a. The system will read the volume serial number label to verify that the disk pack is the correct one (see Illustration #9).

Illustration #9



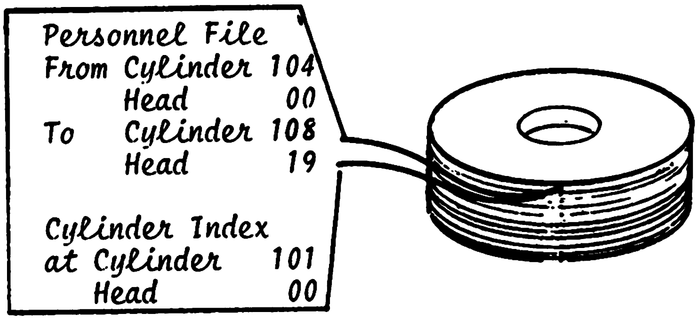
b. If it is the correct disk pack the system will check the volume serial number label to locate the VTOC (see Illustration #10).

Illustration #10



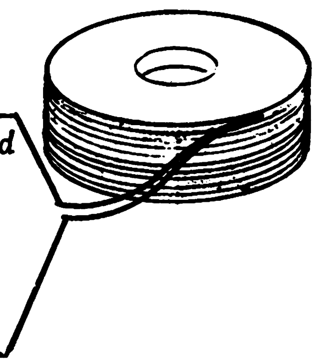
c. Once the read/write heads are located at the VTOC, the computer will check to see if the desired file is on the disk pack, and where the cylinder index of that file is located (see Illustration #11).

Illustration #11



d. Once the read/write heads are at the cylinder index, the computer system will check that index to determine the highest numbered record recorded in each cylinder. After the cylinder that has a record number equal to or greater than the desired has been identified, the system will move the read/write heads to that cylinder number (see Illustration #12).

Illustration #12

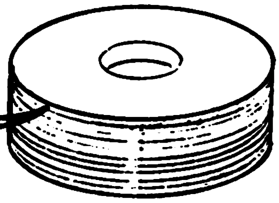


Cylinder	*Highest Record*
104	0200
105	0400
106	0600
107	0800
108	1000

e. Once the read/write heads are positioned at the desired cylinder, the computer system will check a track index to determine which track contains the desired record (see illustration #13).

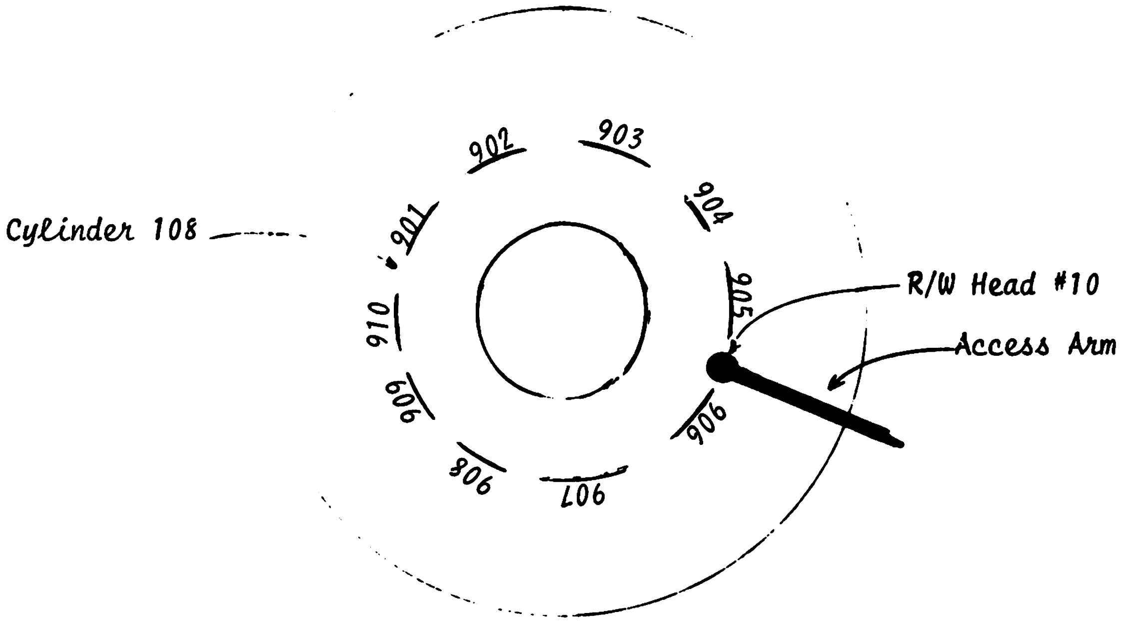
Illustration #13

Track	Highest Record	Track	Highest Record
00	810	10	910
01	820	11	920
02	830	12	930
03	840	13	940
04	850	14	950
05	860	15	960
06	870	16	970
07	880	17	980
08	890	18	990
09	900	19	1000



f. When the track that contains the desired record has been identified, the system will instruct the read/write head to serially read the information on that track until the desired record has been found (see Illustration #14).

Illustration #14



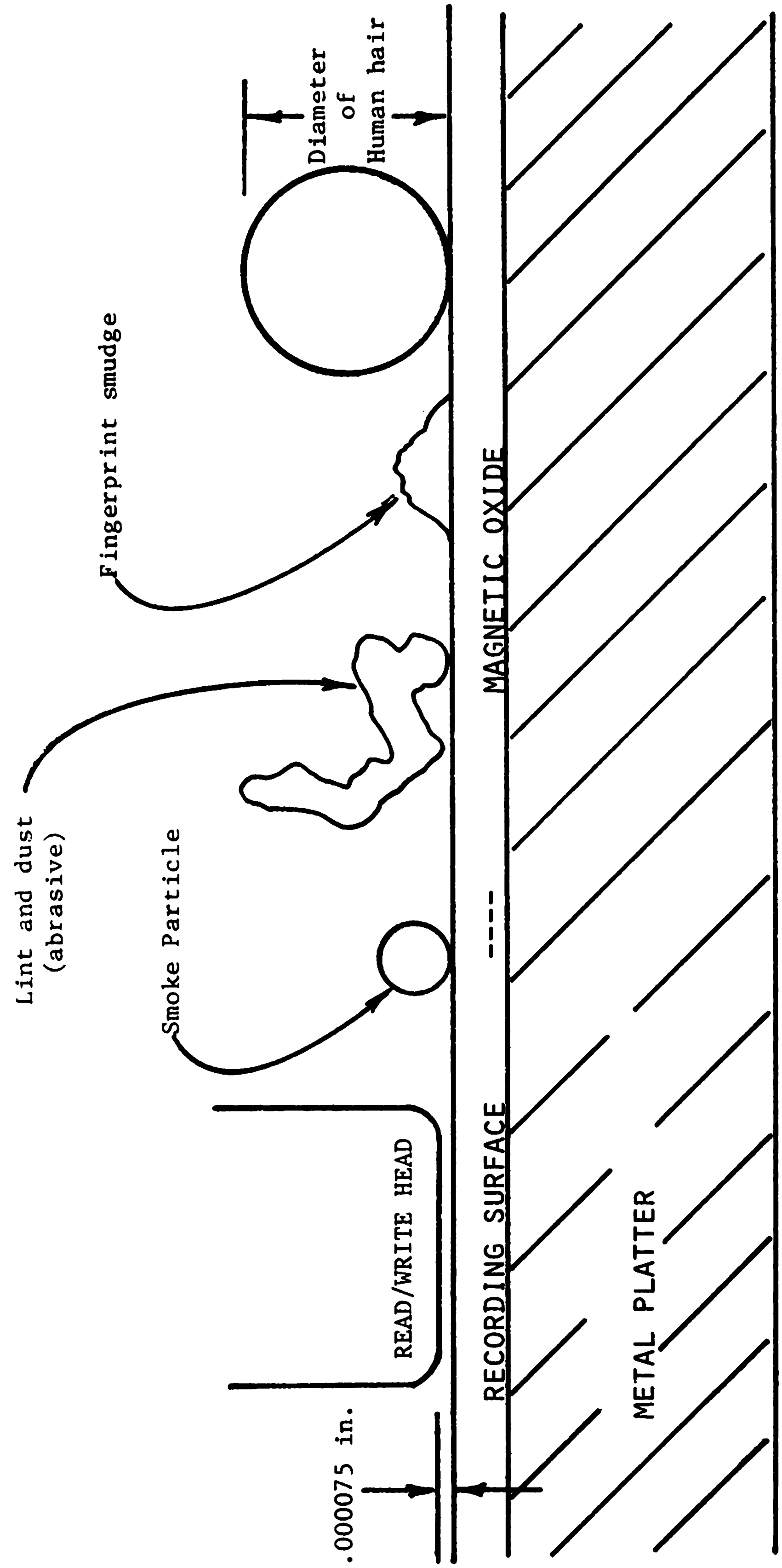
A computer system can accomplish the previous sequence of events in a very short period of time. As a result a tremendous amount of time can be saved by using magnetic disk for input and output.

6. Conditions which Effect the Recording Capabilities of Magnetic Disk.

As previously mentioned, the disk pack rotates at a high rate of speed (i.e. approximately 2400 RPM). At this high rotational speed, if the read/write head was to make contact with the recording surface (oxide coating), an error condition would occur. This condition is commonly referred to as a head crash. This happens when the disk pack is warped in the slightest way due to temperature changes (expansion or contraction), improper handling or shipping of the disk pack, or contaminated computer room environment.

The read/write head's distance from the disk surface is about 0.000075 of an inch. In comparison, a speck of dust or a smoke particle is very large and can actually cause a head crash, or data error.(See Illustration #15).

Illustration #15



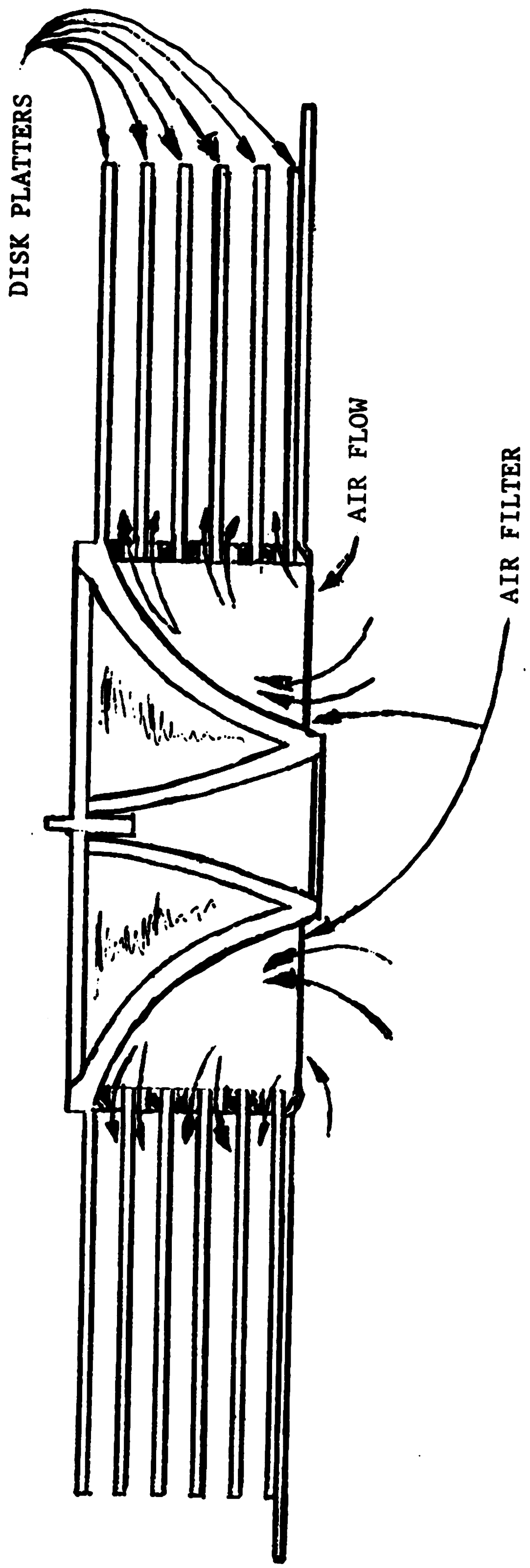
The disk pack, spinning at a high rate of speed solves part of the problem of keeping the dust off the recording surfaces of the pack, by creating an airflow. The air flows through a filter located at the bottom of the disk pack to help free the disk pack of contamination. The air is directed to the surface of each platter by the use of vents between the platters of the disk. Depending on your installation, you might be required to occasionally inspect and even change the filter of the disk pack. Be sure to check your unit's Standard Operating Procedures on how to go about this if you have to change the air filter.

The air flow does not solve the whole problem of keeping the disk pack environment clean, it will be your responsibility to insure that the computer room is kept as clean as possible.

C. SUMMARY: In this chapter, you were introduced to terms that describe the physical characteristics of a disk pack. The term cylinder is used to describe a specific location of the read/write heads on the recording surfaces of a disk pack, while the term track is used to describe the path of data that one read/write head will create around the recording surface of a disk at one location. By using internal labels and indexes on a disk pack, a computer system can skip over needless information. Finally you were shown how important it is for an operator to keep the computer room environment as clean as possible to prevent any contamination of the disk pack.

E. CONCLUSION: One task function of a computer operator is working with disk drives and disk packs in performance of his/her job. A knowledge of how they work and it's basic characteristics is expected of a good computer operator.

Illustration #16



SELF-EVALUATION QUIZ

1. Once the track location of a desired record is located, the system.

   a. Will only read the desired record.
   b. Will read the information on that track until the desired record has been found.

2. What is the name of a group of tracks at the same head position on disk.

   a. Cylinder
   b. File
   c. Cone
   d. Volume

3. What tells the system where the relative area of a particular record is located in a file on a disk pack?

   a. Appendix
   b. Cylinder
   c. Index
   d. Track

4. Each recording surface on a disk pack will have:

   a. VTOCs
   b. Cylinders
   c. Tracks

5. The purpose of the volume serial number label on the disk pack is:

   a. It identifies the disk pack, it tells the system where the indexes are located.

   b. It identifies the disk pack and it tells the location of the VTOC.

   c. It identifies the disk pack and the last date of preventive maintenance.

   d. It identifies the disk pack and the amount of data that is on the pack.

6. What is one purpose of the volume table of contents on a magnetic disk pack?

    a. It tells the computer how many cylinders are on the disk pack.

    b. It tells the computer how many tracks are on the disk pack.

    c. It tells the computer where a file is located on the disk pack.

    d. It tells the computer that a disk pack is mounted.

7. True or False. The magnetic disk must read all the records on a file in order to read the last record. ____________

8. True or False. When a magnetic disk is being used it is placed on a device called a disk drive. ________________________

9. True or False. The upper surface of the top platter of a disk pack is used to record data. _____________

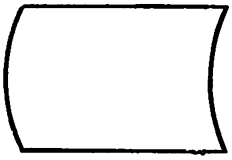
10. True or False. The bottom surface of the last platter of a disk pack is used as protection for the other recording surfaces. _______________

11. True or False. All the read/write heads move at the same time. ______________

12. True or False. Each disk pack has a unique volume serial number. ____________

13. True or False. Temperature changes do not affect the disk pack. ________________

14. True or False. The distance between the disk pack's surfaces and the read/write heads is so large, a speck of dust on the disk's surface will cause no problem. ________



15. The address of a track is determined by:

    a. the VTOC number and cylinder number

    b. the cylinder number and volume number

    c. the index number and read/write head number

    d. the cylinder number and read/write head number

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CHAPTER 6

THE CENTRAL PROCESSING UNIT

A. INTRODUCTION: The Central Processing Unit (CPU) is the heart of the computer system. It receives all the input, processes it, and directs the processed data to the correct output device. It is basically an electronic device that can perform millions of computer instructions in one second. This high rate of speed makes the CPU the fastest of all hardware equipment, and to the average person gives an appearance of possessing mystic powers.

In reality, the CPU is nothing more than a piece of equipment that can perform simple operations at a high rate of speed. It must receive an instruction for every operation it performs. Without instructions, the CPU can do nothing.

As a computer operator, you will not be required to know exactly how the CPU stores or manipulates data, but knowing the basic functions and characteristics of the CPU will help you to perform your job.

B. OBJECTIVE. The objective of this chapter is to give you the necessary information to identify:

1. How information is stored in the CPU.
2. The three components of the CPU.
3. The function of the Control Section.
4. The function of Main Storage.
5. How storage size is represented.
6. The function of the Arithmetic/Logic Unit.
7. The function of the Operator Communication Device.

C. Training Aids: None.

D. Training: The Central Processing Unit is where all the processing of data takes place. This is where classifying, sorting, calculating, editing and selecting are performed.

1. How Information is Stored: The CPU stores information by using electronic impulses. It senses whether or not an impulse is present at a unique position within the CPU. Each unique position is called a bit (binary digit). By using a combination of bits, any type of information can be represented. To illustrate this, let's use binary* to represent numerical values and let's say "1" will represent the presence of an impulse and "0" will represent the absence of an impulse. See illustration #1.

Illustration #1

With one bit, I can represent the values of zero and 1.

Numeric		Binary
0	=	0
1	=	1

By using additional bits, I can represent greater numeric values.

Numeric		Binary
2	=	10
3	=	11
4	=	100
.		.
.		.
.		.
8	=	1000
9	=	1001
.		.
.		.
.		.
17	=	10001
.		.
.		.
.		.
100	=	1100100
.		.
.		.
.		.
.		.
1981	=	11100001001

*Binary is a base 2 numbering system.

By the previous illustration, you can see that numeric values can be represented by using combinations of bits. Many computers use EBCDIC* to represent data. Illustration #2 gives you some examples on how EBCDIC will represent characters.

Illustration #2

Character	EBCDIC
0	1111 0000
1	1111 0001
.	.
.	.
.	.
9	1111 1001
A	1100 0001
B	1100 0010
C	1100 0011
.	.
.	.
.	.
J	1101 0001
K	1101 0010
L	1101 0011
.	.
.	.
.	.
X	1110 0111
Y	1110 1000
Z	1110 1001
.	.
.	.
.	.
$	0101 1011
?	0110 1111

No matter what type of computer you work with, the CPU will use binary digits to represent data and instructions.

*Reference Chapter 4.

2. The 3 Components of the CPU: The Control Section, Main Storage and Arithmetic/Logic Unit (ALU) are the 3 components of the CPU. Briefly stated, the Control Section interprets computer instructions, Main Storage temporarily stores data and instructions, and the ALU performs all the calculations and comparisons.

3. Control Section: The function of the Control Section is to coordinate all the operations of the computer system to meet the requirements of the computer program. It directs all operations occurring in the CPU. It determines when computer instructions are to be executed and when the arithmetic or logic portion of the ALU is to be used. The control section also determines when input data is to be read into main storage, and when output data is to be written to an output device. In short, the control section controls all activities of the computer system.

4. Main Storage: Data and instructions in main storage (the storage area within the CPU) are represented in byte* configuration. At the time main storage is assembled, each byte location is given a unique address. This addressing scheme allows the computer to access any byte in main storage when required. In previous chapters you've learned about punched cards, magnetic tape and magnetic disk. These media are called secondary storage** and can be used for storing data or computer instructions on a permanent basis. Main Storage*** is used to store data and instructions on a temporary basis. The function of Main Storage is to store:

a. Input data that is to be immediately processed.

b. Computer instructions that will accomplish that processing.

c. Processed data that is to be sent to an output device.

5. Storage Size: The size of a computer is usually based upon its main storage capacity. This means the amount of bytes of information that can be held in main storage. K or M is used when stating memory size. 1K of memory is equal to 1,024 bytes, while 1 M**** of memory equals 1,048,576 bytes. When someone states that a computer has 256K, he is referring to the storage capacity of the main storage area in the CPU.

*Reference Chapter 4.
**Also known as external storage or auxiliary storage.
***Also known as internal storage, primary storage, main memory or memory.
****Also known as MEG or Megabyte.

6. Arithmetic/Logic Unit: There are two sections of the ALU, the arithmetic section and the logic section. The arithmetic section performs basic mathematics, i.e, addition and subtraction (multiplication and division are accomplished by repetitive addition and subtraction). In other words, the computer adds a number many times to obtain the answer to a multiplication problem. The same idea holds true for division, it subtracts a number many times.

The logic section makes simple comparisons. The results of those comparisons determine which action the Control Section will execute. To illustrate how the result of a comparison can determine an action, let's consider how a computer would turn a furnace on (See illustration #3).

Illustration #3

Reset Condition: Check the room temperature once every minute. If temperature gets below 70 degrees the furnace will be turned on.

a. The logic portion compares the current temperature reading of 71° to 70°.

   (1) Results of comparison is that the temperature is greater than 70°.

   (2) The Control Section initiates the necessary action to get a new temperature reading in 1 minute.

b. The logic portion compares the temperature reading of 69° to 70°.

   (1) Results of comparison is that the temperature is less than 70°.

   (2) The Control Section initiates the necessary action to turn the furnace on.

The previous illustration is to demonstrate how the result of a comparison can cause actions to be taken, not to show what actions will be taken.

7. Operator Communication Device: All along we've been talking about how the CPU works, how it can do this and how it can do that. The computer, sophisticated as it is, still needs human intervention when it runs into a problem. This is done by the computer displaying a message to the operator and the operator entering a response. The device that provides this communication capabilities is called an Operator Communication Device. The communication device you will be working with here uses a Cathode Ray Tube*(CRT) to display messages and operator responses, and a keyboard (looks like a typewriter keyboard) for operator entries.

SUMMARY: In this chapter we have discussed how data is stored, the three components of the CPU, the functions of each of these components, and finally we briefly covered the operator's communication device.

CONCLUSION: (The Central Processing Unit), the CPU is primarily concerned with Processing, which is one of the 3 Basic Elements of a Computer System. To become a more efficient computer operator you should have a working knowledge of the CPU.

If you feel you have not grasped all the material in this chapter, take time to review this chapter. Some material in this chapter will be used as a foundation for later chapters.

*A TV like screen that presents data electronically.

SELF-EVALUATION

1. The components of the CPU are:
   a. Main Storage, Housing Section, and Control Section.
   b. Arithmetic/Logic Unit, Main Storage, and Control Section.
   c. Main Storage, Arithmetic/Logic Unit and Core Storage.
   d. Core Storage, Main Storage and Control Section.
2. The function of the CPU's Control Section is to:
   a. store processed data that is to be sent to an output device.
   b. perform mathematic functions.
   c. coordinate all operations of the computer system.
   d. control the operations of a DPI.
3. The numbering system that is base 2 is:
   a. Decimal.
   b. Binary.
   c. Octal.
   d. Hexadecimal.
4. The two types of storage are:
   a. Main and Secondary.
   b. Main and binary.
   c. Secondary and external.
   d. Main and internal.

5. One function of the ALU is to:

   a. store processed data that is to be sent to an output device.

   b. coordinate all operations of the computer system.

   c. provide the operator with messages.

   d. make comparisons between given values.

6. True or False. The CPU stores data by using electronic impulses.

7. True or False. The numerical values 0-9, can be represented in binary.

8. True or False. The Central Processing Unit is the fastest of all hardware equipment.

9. True or False. One K of memory is equal to 1024 bytes.

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Chapter 7

Channels, Control Units, and Physical Unit Addresses

A. INTRODUCTION: The central processing unit is primarily used for the processing of information, while channels and I/O control units handle the input/output requirements of a computer system. A physical unit address allows the computer system to retrieve information from a particular input device and to direct processed information to a specific output device. A basic understanding of how channels and I/O control units interface with the CPU and I/O devices, and how physical unit addresses are derived will help you in your job as a computer operator.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. Characteristics of channels.

2. The two types of channels.

3. Characteristics of I/O control units.

4. Characteristics of a physical unit address table.

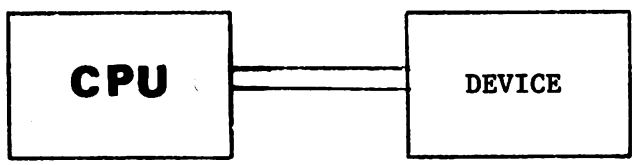
5. The function of a physical unit reference table.

6. The purpose of the automatic device assignment method.

C. Training Aids: None.

D. Training: In the past, the central processing unit (CPU) and the I/O devices were directly linked together. If you recall, the CPU can operate at a high rate of speed while the I/O devices operate at a comparatively lower rate of speed (See Illustration #1).

Illustration #1



With the I/O device and CPU connected together, let's suppose that the CPU is instructed to have the card reader read a card, and then have a tape drive write that record on magnetic tape. The sequence of events may take place as follows:

a. The CPU would give the "read a card" command to the card reader.

b. Then the CPU would have to wait for the card reader to react at its slow rate.

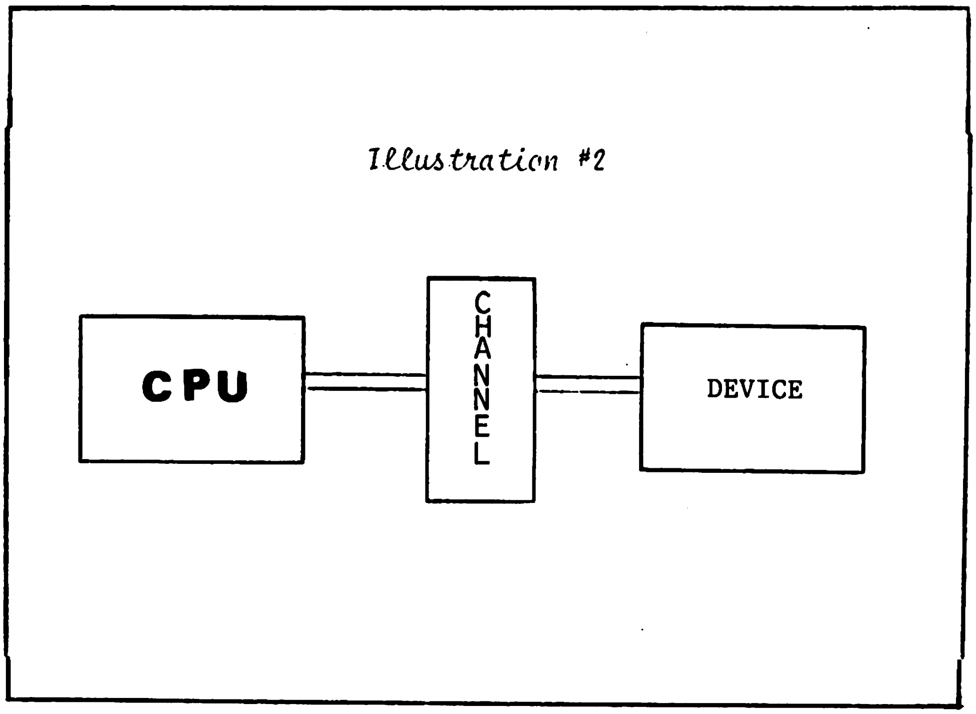
c. The CPU would then give the write a record command to the tape drive.

d. And finally the CPU would again be forced to wait for the tape drive to write the record on the tape.

In the previous example, the CPU would be idle the majority of the time due to the relatively slow speed of the card reader and tape drive. This CPU idle time is lost processing time for a DPI.

1. Channels: A channel* is basically a special purpose computer designed to handle the I/O operation requirements of the CPU.

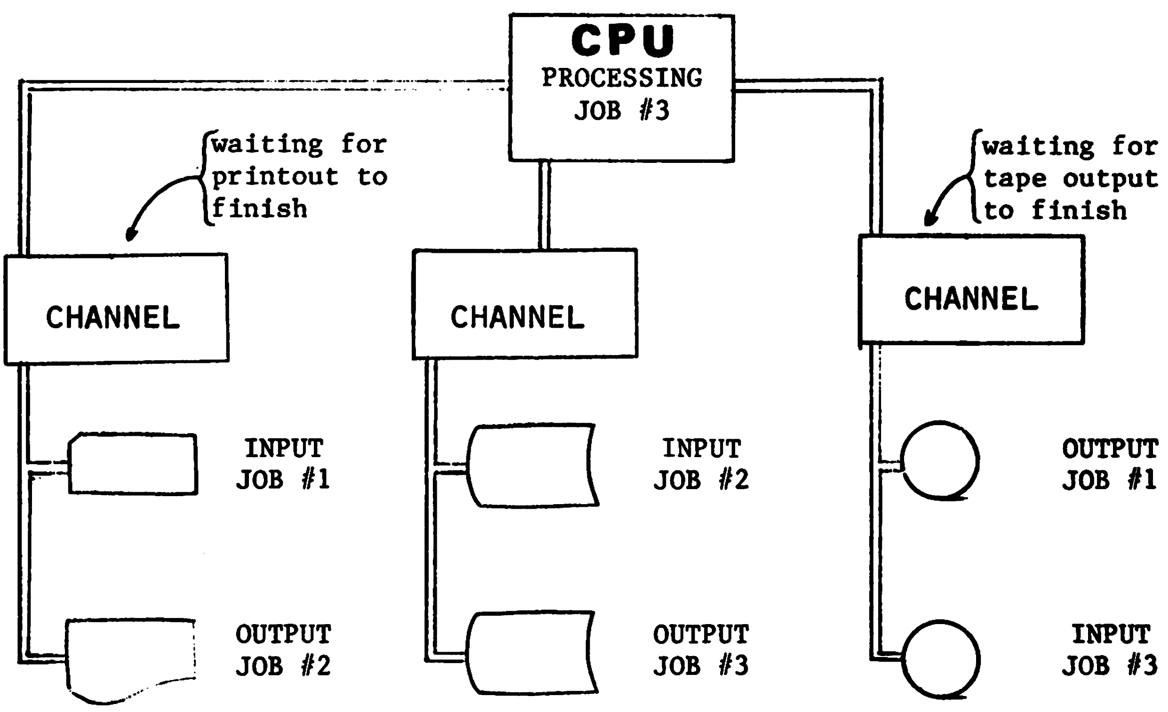
a. The channel can receive instructions from the CPU at its' high rate of speed and in turn will wait for the relatively slow I/O device (See Illustration #2).



*Sometimes referred to as I/O Processor.

b. By connecting several channels to a CPU and several I/O devices to each channel, the CPU can instruct one channel to write a record, instruct another channel to write a record for a different job, and while the channels are handling the I/O operational requirements, the CPU can be processing information for a third job (See Illustration #3).

Illustration #3



The idea of channels handling the I/O operation requirements gives the CPU the ability to do more "PROCESSING".

2. Types of Channels: As a computer operator you may hear terms that describe the types of channels which are connected to a CPU (for this course it is necessary to know only the types of channels). Generally speaking, there are two types of channels, they are multiplexor and selector.

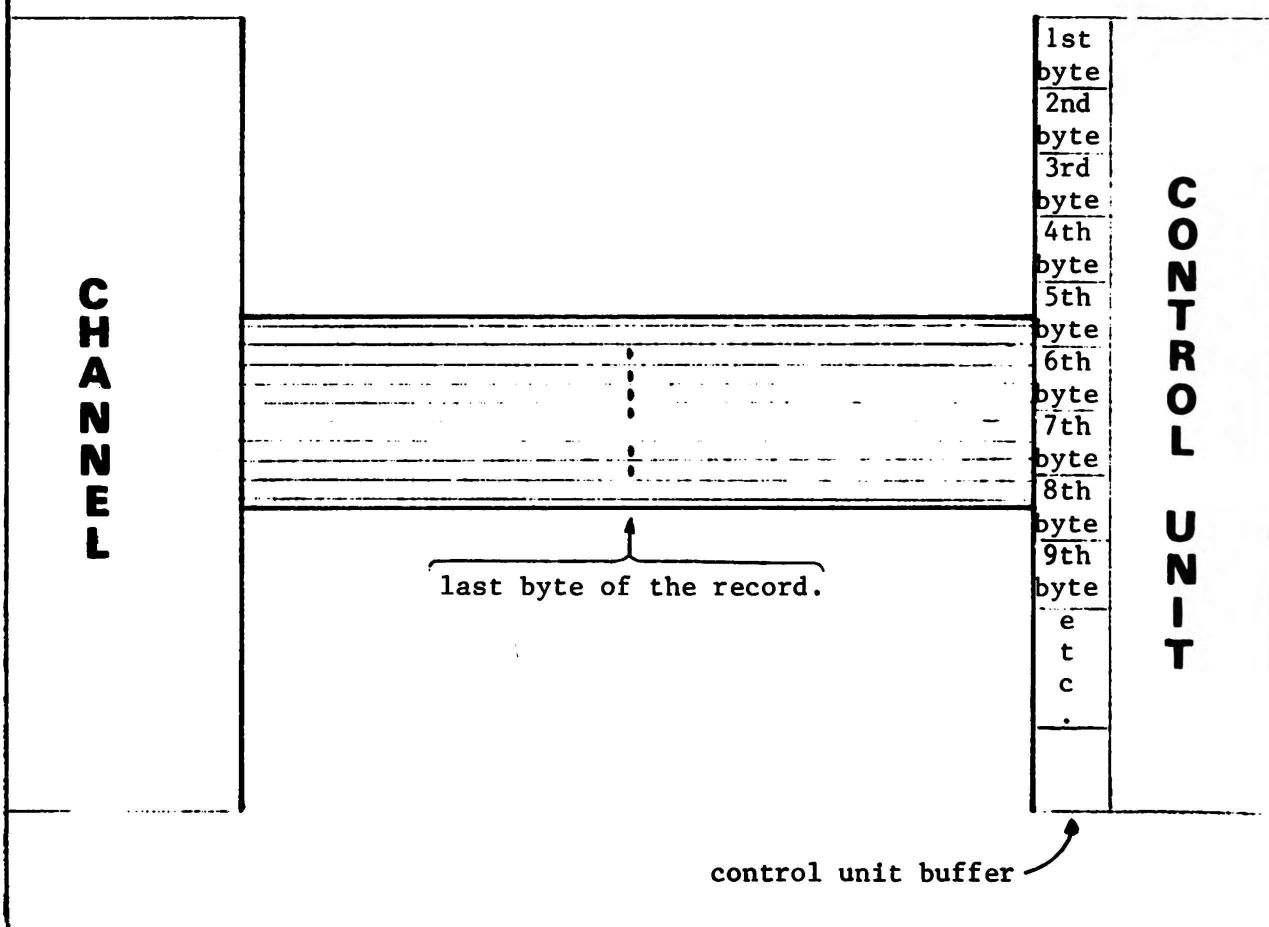
a. Multiplexor: The multiplexor channel can work with several devices at one time, and is normally attached to low speed devices such as card readers, printers, and card punches.

b. Selector: The selector channel will work with one device until the complete record is sent to the device. This type of channel is always attached to high speed I/O devices such as tape drives and disk drives.

3. I/O Control Units: An I/O control unit performs two important functions, it serves as a buffer and it serves as an interpreter.

a. Buffering: In the past, when the CPU required a record to be written to a device it would send a byte (character) through the communication link, wait for the device to write that byte, and then send another byte. This procedure would be repeated until the whole record was written. The buffering feature of the control unit allows the channel to send a complete record a byte at a time, at the high rate of speed of the channel. Once the whole record has been received by the control unit, the control unit sends a byte to the device and waits for that byte to be written (See Illustration #4).

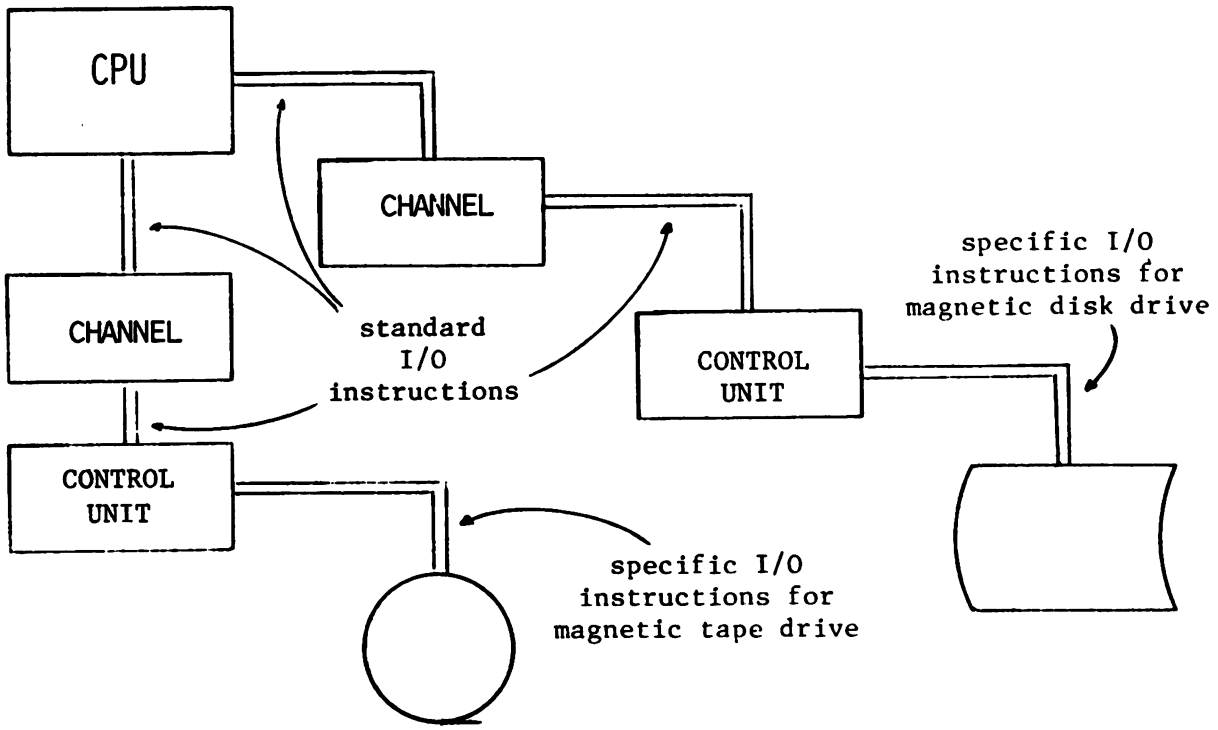
Illustration #4



b. Interpreter: A control unit serves as an interpreter between the channel and the device. Each type of I/O device attached to a CPU requires a specific set of I/O instructions. Without those instructions the device could not be used by the CPU. In the past, these I/O instructions had to be stored in the CPU.

By control units issuing specific I/O instructions to the devices, the CPU has more memory available for processing. With control units the CPU can issue a standard input or output command to the channel. The channel issues that command to the control unit, and the control unit will issue specific instructions to the device. (See Illustration #5).

Illustration #5



By the CPU using standard I/O commands, any control unit that can respond to those commands can be attached to the computer system. In turn any I/O device whose control unit can be attached to the computer system can be used. This concept is called standard interface.

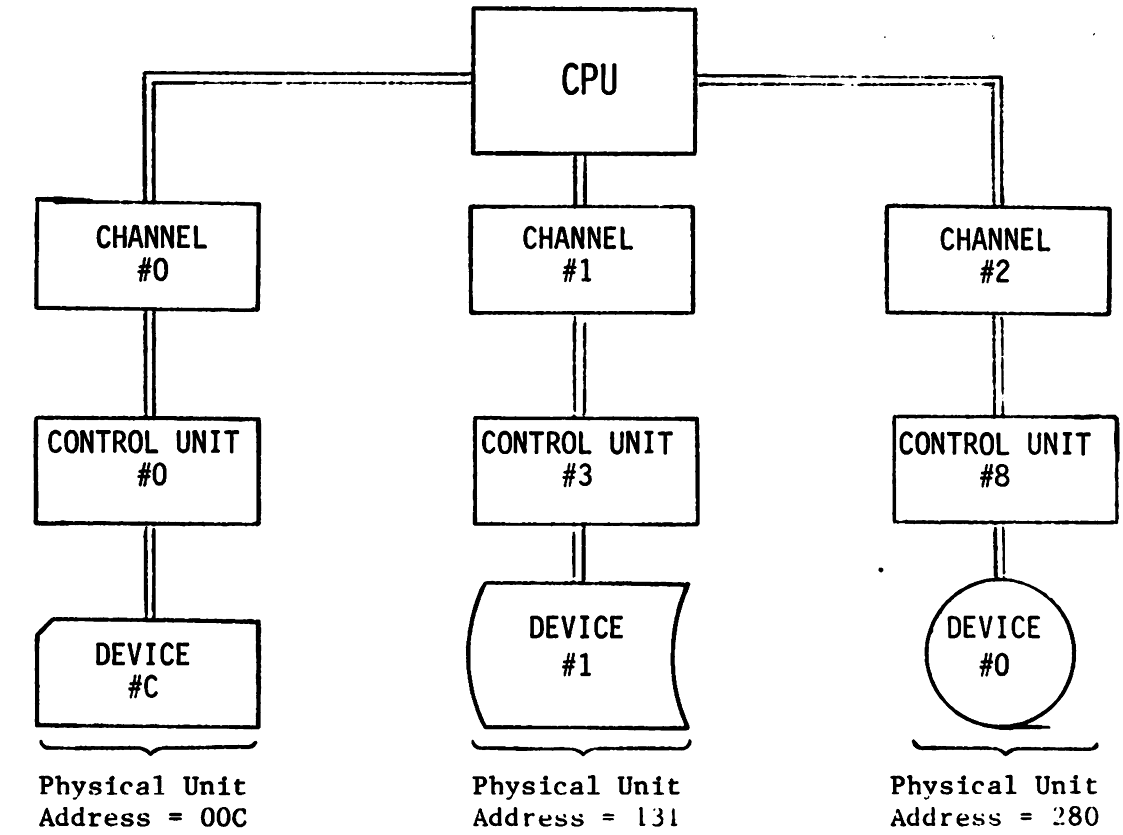
4. Physical Unit Address: Each I/O device within a computer system must have a specific identity. This identity is known as the physical unit address. No two devices attached to a computer will have the same address. The physical unit address of an I/O device is derived from:

a. the number of the channel that the control unit of the device is attached to,

b. the number of the control unit,

c. and the number of the device itself (See Illustration #6).

Illustration #6



In illustration #6, the character "C" was used to represent a number of a device. This is because the hexadecimal numbering system was used to illustrate physical unit addresses. The hexadecimal system (base 16) uses 16 characters to represent values. While the decimal system (base 10) uses 10 (See Illustration #7).

Illustration #7

Decimal Value	Hexidecimal Value
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F
16	10
17	11
18	12
19	13
20	14

By looking at illustration #7, you can see that once the decimal numbering system has used its ten characters, it starts a second position to represent greater values. Hexidecimal uses 16 characters before it starts using a second position.

As an operator, you most likely will see physical unit addresses being represented by the hexadecimal numbering system.

5. Physical Unit Reference Table: A physical unit reference table* is used by the computer system for I/O device specification purposes. Each device, used by the CPU, must have an entry in the table that specifies its

*Sometimes referred to as a Physical Unit Block or Unit Control Block.

physical unit address and type. If an I/O device is not specified in the table, it will not be used by the CPU. The table is normally created at the time the computer system is initially configured. If a DPI wishes to attach a new device to its system an entry to the table must be made for that device. As a computer operator, you may be required to make additions or deletions to a Physical Unit Reference Table whenever a new device is attached to or removed from the system.

6. Automatic Device Assignment Method: The purpose of the Automatic Device Assignment Method (ADAM) is to increase the flexibility of an Army computer system. The Army has many DPI's throughout the world. Each DPI may have particular requirements that it must fulfill, but they also have numerous jobs that are common within every DPI (i.e., personnel jobs, supply jobs, etc.).

Computer instructions for these common jobs are written at a central location and then distributed (by magnetic tape) to every DPI that requires them. Included in these computer instructions are specific instructions that indicate which I/O device or devices the job requires. Under normal conditions these instructions will indicate the I/O devices by their physical unit address. However, a computer system in the Army may differ slightly from DPI to DPI. For example: One DPI may have its tape drives on channel 2 while another DPI may have its tape drives on channel 1. Even though the control unit number is the same (i.e., "8") and the device number is the same (i.e., "0") the physical unit address, of the device, for the DPI using channel 2 would be 280 while the DPI using channel 1 would have a physical unit address of 180.

The ADAM uses symbolic identifiers in place of physical unit addresses. These symbolic identifiers enable the instructions to be executed regardless of the physical unit address. By providing an ADAM's table (reference) to the computer system, the computer will check this table whenever a symbolic identifier is read to determine what physical unit address it will use. (See Illustration #8). As an Army computer operator, you will most likely be working on a system that uses the ADAM. Your computer run instructions may also use the ADAM identifiers to indicate I/O requirements.

Illustration #8

ADAM Symbolic Identifier	Physical Unit Address	ADAM Symbolic Identifier	Physical Unit Address
CR0	00C	DK0	130 or 140
PR0	00E	DK1	131 or 141
CP0	00D	DK2	132 or 142
TP0	180 or 280	DK3	133 or 143
TP1	181 or 281	DK4	134 or 144
TP2	182 or 282	DK5	135 or 145
TP3	183 or 283	DK6	136 or 146
TP4	184 or 284	DK7	137 or 147
TP5	185 or 285		

CR = Card Reader
PR = Printer
CP = Card Punch
TP = Tape Drive
DK = Disk Drive

E. Summary: In this chapter the functions and characteristics of channels, control units, physical unit addresses, physical unit reference tables, and the automatic device assignment method were covered.

1. Channels, acting as special purpose computers, relieve the CPU of the I/O operation which allows more time for processing. This results in less time to complete a job.

2. The two types of channels are multiplexor and selector.

3. Control units translate standard commands given by the channel, and provide buffering capabilities to increase the efficiency of the system.

4. Physical unit addresses are used to access devices attached to the computer system.

5. Physical unit reference tables are used by computer systems to determine what devices are attached to them.

6. The Automatic Device Assignment Method (ADAM) is used by the Army to identify physical I/O devices by using symbolic identifiers.

F. Conclusion: As a computer operator you will be working with these devices and concepts daily. Knowledge of these devices and concepts will help you become more efficient as a computer operator.

SELF-EVALUATION QUIZ

1. Using the base 16 numbering system, which of the following would be a valid physical unit address?

   a. 01G
   b. 10X
   c. 00C
   d. 10H

2. Which one of the list below is a channel?

   a. Direct
   b. Selector
   c. Control
   d. Indirect

3. The numbering system, that is base 16 is:

   a. Binary
   b. Octal
   c. Hexadecimal
   d. Decimal

4. A Physical Unit Reference table is used:

   a. by a computer system for I/O device specification purposes.
   b. by the DPI manager to determine I/O device specifications.
   c. by the channel to determine the size of the block of data that is being sent to a physical unit.
   d. by the DPI to determine the number of channels that are available to the computer.

5. One function of an I/O control Unit is:

   a. to translate the standard I/O commands into signals the I/O device can understand.
   b. to control the channels of a computer system.
   c. to issue control statements to main memory.
   d. to control Input and Output commands between the CPU and the channels.

6. The purpose of a channel is:

   a. to allow the CPU to address a particular area in main memory.
   b. to handle the I/O operation requirements of the CPU.
   c. a cable that connects the I/O Control Unit to an I/O device.
   d. a special tube that circulates water throughout the CPU for cooling purposes.

7. The ADAM is a method developed by the Army to:

   a. use the first computer instruction to determine the function of the job.
   b. use symbolic identifiers to represent physical unit addresses.
   c. determine if the computer that is running a job is an old one or not.
   d. determine if the job that is running on the computer is outdated.

8. True or False: In an address of 184, one is the device number.

9. True or False: Physical Unit Addresses are used to identify I/O devices.

10. True or False: The CPU and I/O devices operate at the same speed.

11. True or False: Channels are basically special purpose computers.

12. True or False: Channels are either the multiplexor or selector type.

13. True or False: The control unit translates the signals of the channel into signals the I/O device can understand.

14. True or False: Buffering allows a record to be transferred at a high rate of speed.

15. True or False: Channels help reduce CPU wait time.

16. True or False: Only one device may be attached to a channel.

17. True or False: Any I/O device whose control unit can respond to the standard I/O commands of the system can be used.

18. True or False: In an address of 236, the 2 is the channel number.

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CHAPTER 8

COMPUTER PROGRAMS

A. INTRODUCTION: A computer program is a set of computer instructions that give a computer a step by step sequence of events to perform (e.g. Adding two numbers together). Generally speaking, computer programs fall into one of two categories. These categories are supervisory (executive software) and application (user software). Supervisory programs are normally provided by the computer manufacturer. They basically control the input, processing and output functions of the computer. On the other hand, application programs are normally written by programmers within the data processing installation. They tell the supervisory programs what must be done. Application programs are written to meet the requirements of the DPI. (e.g. Provide personnel reports to the personnel section.)

You will not be required to write programs. However, an understanding of the basic principles of a program will help you perform your duties in a more efficient manner.

B. OBJECTIVE: The objective of this chapter is to give you characteristics of programs and the necessary information to identify the functions of:

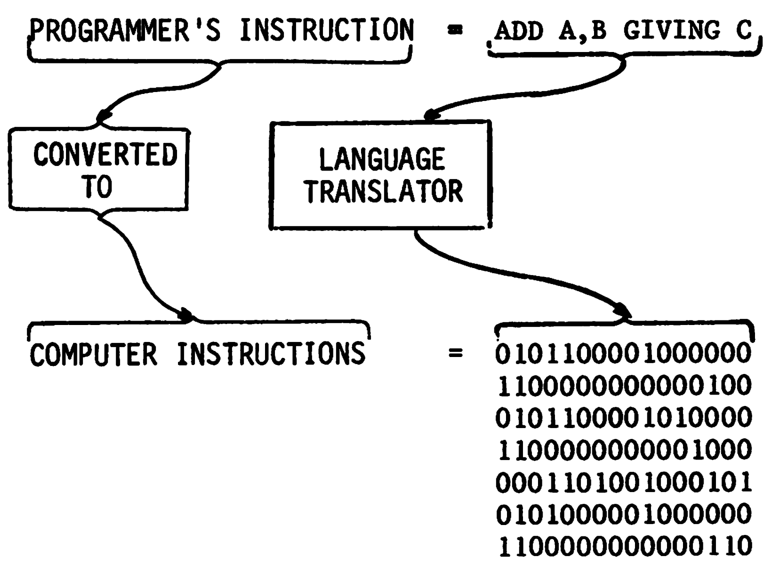
1. A language translator.
2. A program library.
3. A program name.
4. Program messages.
5. Control cards.
6. Two types of symbolic names.
7. An operating system.

C. TRAINING AIDS: None.

D. TRAINING: When creating a program, the programmer must first define the input, processing, and output requirements of the program. The next step is to write the instructions that will accomplish those requirements. Those coded instructions must be converted to machine language before any processing can be done.

1. Language Translator: Manufacturers of computer systems usually provide the language translators. A language translator is a special program which converts the programmer coded instructions to machine language. This function allows the programmer to code his instructions in human readable format. As a result, the programmer doesn't need to know the actual computer instructions. Once passed through the language translator those coded instructions become binary instructions which dictate actions that will be performed by the computer. To better understand the function of a language translator let's look at the task of adding two numbers together (see illustration #1).

Illustration #1



The programmer's coded instruction says to add 2 numbers together. This coded instruction is converted by the language translator to 7 binary instructions which will add those 2 numbers together.

By the previous illustration it becomes apparent that the coded instruction is really symbolic (It means nothing to the computer). The act of passing coded instructions through a language translator is commonly referred to as compiling a program.

During the process of compiling, the translator will attempt to convert every coded instruction. The translator will also determine if that instruction can be performed by the computer. If one or more instructions cannot be converted or performed, an error listing will be provided to the programmer. A program that passes through a language translator without error conditions, is said to have a "clean compile".

Once a program receives a clean compile it must be tested. The purpose of the test is to insure that the program will meet the input, processing, and output requirements that were defined. Once the program meets those requirements, it becomes ready for normal processing operations.

2. Program Library: A program library is an organized collection of computer programs available for rapid retrieval. Compiling a program is a time consuming process. Programs which are going to be used many times are usually saved on magnetic disk in binary format. We can then load a copy of the instructions into main storage whenever we need it.

3. Program Name: A program name is used for program identification purposes. When the programmer writes instructions that will place a program in the program library (catalogues the program) one instruction gives a name to the program. That name must be different from the name of any other program catalogued in the library. The DPA can retrieve a program for execution by using its unique name.

The programmer should prepare documentation throughout the creation of the program. This documentation falls into several categories. These categories are:

a. Definition of the program.

b. Explanation to the user of the output.

c. Instructions to the people who prepare input for the program.

d. Processing instructions for the program when executed.

The last two categories of documentation are of particular interest to those personnel responsible for insuring the program is executed properly (YOU!). Included in the documentation that you will receive are control card information, program message information, and symbolic names used by the program.

4. Control Cards: In general terms, a control card gives the Program the ability to provide options required by the user's needs. During the development of the program, the programmer may find that several output options are needed by the user. One way the programmer may satisfy this requirement is by using a control card. The control card is a punched card that contains information (possibly in code) which will select options that are provided by the program.

5. Program Messages: Program messages give the programmer the capability of providing communication to the computer operator. This communication may be information only, or it may require the operator to perform some type of action.

6. Symbolic Names: The two symbolic names you will be concerned with are File Name (data definition name) and Logical Unit.

a. File Name/Data Definition Name: In addition to receiving detailed instructions for every action it performs, the computer must have a definition of the record it is processing and a definition of the file that the record is read from or written to. This definition must be available to the computer each and every time a record is read, processed, or written.

When coding a program the programmer will prepare a data definition block for each file. This block is where the programmer will define the record and file. Included in the definition will be the length of the logical record and physical record.

One other thing the programmer must do is to give each data definition block a name. The title of this name is dependent upon the type of computer. Two common titles that refer to that name are File Name and Data Definition Name.

Before the program is executed, the "Data Set Name"* of each file that has header label information must be matched to the correct "File Name". This procedure will insure that the program will process the correct data.

* See Chapter 4

b. Logical Unit: A logical unit allows the programmer to indicate where a file will be located without stating a Physical Unit Address. Some computer systems require the programmer to state the unit address of the file. This address will be included in the data definition block. However, it is very difficult for the programmer to determine which physical unit will have the file.

Let's take tape drives for example, and let's say their Physical Unit Addresses range from 180 to 185.

Now let's say the programmer stated that the file would be on tape drive unit 180. As long as tape unit 180 is available to the program there will be no problem. However, if 180 was malfunctioning the program could not be executed. The fact that tape drive units 181 through 185 are available doesn't help.

Because of this problem the computer manufacturer provided logical units.

What the programmer will enter into the data definition block will be a Logical Unit. Now, just before the program is executed that "Logical Unit" must be matched to a Physical Unit Address.

7. Operating System: The purpose of an Operating System is to improve the productivity of the computer. The term "Operating System" refers to those supervisory and operational programs that manage and control the operation of the computer. It usually comes with the computer when purchased. To better understand the function of an operating system, let's look at the three basic categories which these programs fall into. Those categories are System Initialization, Job Management, and Input/Output Management.

a. System Initialization: The function of system initialization is to prepare the computer system for work. System initialization includes:

(1) The loading of the Operating System Nucleus. All the programs that make up an operating system are usually kept on a disk pack (System Residence Pack). At system initialization time, only those programs that must reside in main memory during the active operation of the computer are loaded. Those programs are the operating system nucleus.

(2) The setting of the time and date. The operator will normally key in this information. This information will be used for job accounting purposes.

(3) The loading of reference tables. Reference tables provide needed information when the computer system is processing. This information may include:

(a) The type of equipment connected to the CPU.

(b) The physical unit addresses of the equipment.

(c) The valid logical units for that system.

b. Job Management: The function of job management is to load and start a job, and to end the job. Some things that job management programs do are:

(1) Reads a job into the computer.

(2) Insures that all the I/O Devices required by a program are available.

(3) Insures correct magnetic media input files are used.

(4) Insures unexpired magnetic media files are not used as output.

(5) Writes header and trailer labels on magnetic media output data.

(6) Loads and starts a program in the correct area in main memory.

c. Input/Output Management: The function of Input/Output management is to provide input/output support to an application program while it is processing. When a program requires input or output support (read or write a record) an I/O routine (small input or output program) will be started. This routine allows the channel to control the I/O operation.

E. SUMMARY: In this chapter you've learned that language translators allow programers to code programs in human readable language. That program libraries contain programs which can be retrieved whenever required by using a unique name for each program. That control cards offer options to the user, and that program messages provide information to the operator. That the two symbolic names you will be concerned with are File Name and Logical Unit. And finally, you've learned that an Operating System improves the productivity of the computer.

F. CONCLUSION: Before continuing on to the next chapter, answer the questions in the self-evaluation quiz to insure you have met the objectives of this chapter. Following chapters will reference the material presented in this chapter.

SELF-EVALUATION QUIZ

1. From the list below, who has the responsibility to code a program.

    a. DPI Manager.

    b. Shift Supervisor.

    c. Programmer.

    d. Computer Operator.

2. From the list below, what does a language translator do?

    a. Converts the machine languague to programmer code instructions.

    b. Converts the programmer code instructions to machine language.

    c. Converts Supervisory programs to application programs.

    d. Converts one type of machine language to another type of machine language.

3. From the list below, which is the act of passing coded instructions through a language translator commonly referred as?

    a. Compiling a program.

    b. Converting a program.

    c. Translating a program.

    d. Correcting a program.

4. The reason a program is tested is to insure:

    a. That the language translator can interpret each coded instruction of the program.

    b. That an instruction can be performed by the computer.

    c. That a clean compile is obtained.

    d. That the program will meet the input, processing, and output requirements that were defined.

5. A program library is:

a. An organized collection of computer programs available for rapid retrieval.

b. A special program which converts the programmer coded instructions to machine language.

c. A room which has all the magnetic tapes that contain the programs that are processed on the computer.

d. A reference list of the organized collection of programs.

6. A program name is used for program identification purposes and is given to the program by:

a. DPI Manager.

b. Shift Supervisor.

c. Programmer.

d. Computer Operator.

7. From the list below, which one gives the programmer the ability to provide options required by the user's?

a. Program Name.

b. Program Message.

c. Symbolic Name.

d. Control Card.

8. From the list below, which one gives the programmer the capability of providing communication to the computer operator.

a. Program Name.

b. Program Message.

c. Symbolic Name.

d. Control Card.

9. From the list below, what must a file name be matched up to?

   a. Program Name.

   b. Physical Unit Address.

   c. Logical Unit.

   d. Data Set Name.

10. From the list below, what must a logical unit be matched up to?

   a. Program Name.

   b. Physical Unit Address.

   c. File Name.

   d. Data Set Name.

11. What does the term "Operating System" refers to?

   a. Those supervisory and operational programs that manage and control the operation of the computer.

   b. Those programs that must reside in main memory during the active operation of the computer.

   c. Those special programs which convert programmer coded instructions to machine language.

   d. All programs that are written to meet the requirements of the DPA.

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CHAPTER 9
JOB CONTROL LANGUAGE

A. INTRODUCTION: Have you ever wondered what tells the computer when to run a program, what program to run, where to get all the input it needs, and where to put the output it creates? The answer to these questions is job control language (JCL). JCL is a language that is used to identify a program and describe its requirements to the computer. Without JCL the link between the program and the computer would be virtually impossible. As a computer operator, you will most likely be working with JCL in your everyday environment. Although you may not have the responsibility to determine what JCL is required, an understanding of JCL will help you as a computer operator.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. The function of JCL.

2. The particular function of each of the following JCL statements.

   a. // JOB

   b. // ASSGN

   c. // TLBL

   d. // DLBL

   e. // EXTENT

   f. // EXEC

   g. /*

   h. /&

   i. *

TRAINING AIDS: The following supportive materials will be needed to complete the above objectives:

None.

D. TRAINING: In this chapter, you will see how JCL prepares the computer internally for the processing requirements of a program.

1. FUNCTION: The function of JCL is to:

. inform the CPU when a job is to be run,

. indicate what input and output devices are to be used by a program,

. specify data set names of magnetic input, or output, for verification purposes,

. specify which program is to be loaded into main memory for processing,

. indicate no more data card input is available,

. and finally to indicate that end of job has been reached.

In order to better understand these functions, let's say that a DPA needs to put data cards on magnetic tape.

a. First of all, a program must be written by a programmer that will meet the input/output requirements of the above stated problem. To better understand the requirements of a program, a sample program, in laymen's terms, is provided below.

(1) The name of the program is P19HRD.

(2) The input media will be cards, and the physical unit address of the input device will be wherever SYS016 is assigned.

(3) The output file name will be E19HRD and the physical unit address of the output device will be whereever SYS006 is assigned.

(4) E19HRD is defined as follows:

. The record is 80 characters in length,

. 10 records (logical records) will be in each block of records (physical records),

. the file will have a header label and a trailer label,

. and the output will be on tape.

(5) Perform the following instructions:

(a) Read a card from logical unit SYS016.

(b) If no more data cards end the program, otherwise go to the next step.

(c) Write input record to logical unit SYS006.

(d) Start over again at step (a).

b. Now that there is a program written, JCL needs to prepare the computer internally for processing the program. This is accomplished by JCL statements.

PROGRAM REQUIREMENTS	JCL	JCL FUNCTION
	// JOB CARD-TO-TAPE	Informs the CPU that a job called Card-To-Tape is to be run.
The input media will be on cards. The logical unit to be used is SYS016.	// ASSGN SYS016,X'CRO'	Directs the CPU to use physical unit CRO whenever SYS016 is used.
The output media will be on Magnetic tape. The logical unit used is SYS006.	// ASSGN SYS006,X'TP2'	Directs the CPU to use physical unit TP2, whenever SYS006 is used.
The filename is E19HRD.	// TLBL E19HRD,PAYMST	Directs the CPU, if the tape is input, the data set name in the header record of the tape must be PAYMST, or if the tape is output, to write the data set name PAYMST in the header record.

The name of the program is P19HRD	// EXEC P19HRD	Directs the CPU to get the program called P19HRD from the program library, load it into main memory, and execute the program instructions.

c. Thirdly, the computer needs to perform the program instructions until all data input cards are read.

PROGRAM INSTRUCTIONS	JCL or DATA CARDS	JCL FUNCTION
read a card	data card	N/A
write a card	-	N/A
read a card	/*	Informs the CPU that no more data cards are available.

END The Program.

d. Fourthly, once the program is through, JCL will again be required to indicate whether the job is finished or not.

JCL	
/&	Informs the CPU that no more processing is needed to satisfy the requirements of the job.

2. Function of JCL statements:

As a computer operator, you have to enter these JCL statements to the computer system by means of the card reader or through the console typewriter. You are not responsible for the contents of the JCL deck, but you have to make sure that the deck is complete, this is done by using a listing provided by the programmer. If you understand the function of each JCL statement, you will be able to determine what is required of a job.

The function of the JCL statements you will most likly see is as follows:

a. // JOB Tells the CPU that a Job is to be run and the job name of that job.

b. // ASSGN Tells the CPU that a specified logical unit is to be assigned to a specific physical unit address.

c. // TLBL Tells the CPU what data set name must be in the header record of the tape file when a particular file name is used.

d. // DLBL Tells the CPU what data set name must be for a disk file when a particular file name is used.

e. // EXTENT Tells the CPU the volume serial number of a disk pack and what area of that disk pack a particular file is going to be on.

f. // EXEC Tells the CPU what program is to be executed.

g. /* Tells the CPU that the last card of input data cards has been read. (Disk and tape input do not need a special card because of their EOF trailer labels.)

h. /& Tells the CPU that the job is finished.

i. * Tells the CPU to display a message (comment) to the operator. (This JCL statement does not have anything to do with the actual processing of the program.)

E. SUMMARY: In this chapter, the functions of JCL has been discussed, and the particular function of JCL statements where itemized.

F. CONCLUSION: As a computer operator, you will be dealing with JCL on a daily basis. A knowledge of JCL will enable you to do your part as an operator to insure the computer job is completed on time.

END

SELF EVALUATION

1. As a computer operator, you:

   a. Are responsible for the contents of the JCL deck.

   b. Must make sure that the JCL deck is complete.

   c. Must determine JCL requirements of an application program.

   d. Have to make a listing of JCL that is required of an application program.

2. The function of the "// EXEC" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

   e. Tells the CPU what program is to be executed.

   f. Tells the CPU to display a message to the operator.

   g. Tells the CPU what data set name must be in the header record of a tape file.

   h. Tells the CPU what the data set name must be for a disk file.

3. The function of the "// JOB" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

e. Tells the CPU what program is to be executed.

f. Tells the CPU to display a message to the operator.

g. Tells the CPU what data set name must be in the header record of a tape file.

h. Tells the CPU what the data set name must be for a disk file.

4. The function of the "// DLBL" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specified physical unit address.

   e. Tells the CPU what program is to be executed.

   f. Tells the CPU to display a message to the operator.

   g. Tells the CPU what data set name must be for a disk file.

5. JCL is:

   a. a language used to issue program instructions to the computer.

   b. a language used to identify a program and describe its requirements to the computer.

   c. a system used by the computer to identify internal memory locations.

6. The function of the "*" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

   e. Tells the CPU what program is to be executed.

   f. Tells the CPU to display a message to the operator.

   g. Tells the CPU what data set name must be in the header record of a tape file.

   h. Tells the CPU what the data set name must be for a disk file.

7. The function of the "/*" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

   e. Tells the CPU what program is to be executed.

   f. Tells the CPU to display a message to the operator.

   g. Tells the CPU what data set name must be in the header record of a tape file.

   h. Tells the CPU what the data set name must be for a disk file.

8. The function of the "// TLBL" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

   e. Tells the CPU what program is to be executed.

   f. Tells the CPU to display a message to the operator.

   g. Tells the CPU what data set name must be in the header record of a tape file.

9. One function of JCL is:

   a. To define input/output files for the program.

   b. To indicate what logical units the program must use.

   c. To indicate what input and output devices are to be used by a program.

   d. To give a program a specific name.

10. The function of the "// ASSGN" JCL statement is:

   a. Tells the CPU that a job is to be run.

   b. Tells the CPU that a job is finished.

   c. Tells the CPU that the last input data card has been read.

   d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

e. Tells the CPU what program is to be executed.

f. Tells the CPU to display a message to the operator.

g. Tells the CPU what data set name must be in the header record for a tape file.

h. Tells the CPU what the data set name must be for a siak file.

11. The function of the "/&" JCL statement is:

a. Tells the CPU that a job is to be run.

b. Tells the CPU that a job is finished.

c. Tells the CPU that the last input data card has been read.

d. Tells the CPU that a specified logical unit is assigned to a specific physical unit address.

e. Tells the CPU what program is to be executed.

f. Tells the CPU to display a message to the operator.

g. Tells the CPU what data set name must be in the header record of a tape file.

h. Tells the CPU what the data set name must be for a disk file.

12. True or False. A data set name is the name written to magnetic output media by the computer.

13. True or False. The // JOB statement tells the computer the data set name.

14. True or False. The // ASSGN statement tells the computer the Job name.

15. True or False. The // TLBL statement tells the computer the program file name and data set name of the tape.

16. True or False. The // EXEC statement tells the computer which devices will be used.

17. True or False. The // EXTENT statement tells the computer on which disk and on what area of that disk a particulat file is located.

NOTES

CHAPTER 10

Concepts In Computer Processing

A. INTRODUCTION: Now that you have a basic understanding of how a computer system works, you can be introduced to several concepts in computer processing that will help you perform your job as an operator. The importance of the material in this chapter cannot be expressed enough. You should read the contents of this chapter until you fully understand all the material covered.

B. OBJECTIVE: The objective of this chapter is to give you the necessary information to identify:

1. The characteristics of a job stream.

2. The benefits of disk JCL.

3. The characteristics of multiprogramming.

4. Methods of job management.

5. The characteristics of spooling.

6. The characteristics of batch processing.

7. Rerun and restart procedures.

C. TRAINING AIDS: None.

D. TRAINING: In the previous chapter you learned that the beginning of a job is indicated by a // JOB statement and the end of a job is identified by the /& JCL statement.

1. Characteristics of a Job Stream: A job stream consists of one or more jobs placed together in one batch. This method of batching jobs into a job stream saves valuable time by allowing the computer operator to load all jobs at one time rather than loading each job separately.

a. Job (Run): A job consists of one or more programs that are run in sequence to create outputs and update data files. A job is also referred to as a "Run."

b. Job Step (Subset): A job step is a program that is executed within a job. The amount of job steps within a job is determined by the amount of programs that are executed between the // JOB and the /& JCL statements (See Illustration #1). A job may contain one program or several programs. The amount of programs within a job depends on the requirements of that job. If a job needs only one program to satisfy the job requirements, it is considered to be a one step job. At times, several programs may be needed to complete the requirements of a job. To illustrate this let's look at the 3 step job shown in illustration #1:

(1) The first step may be to load payroll update cards to tape.

(2) The second step may be to use the output tape from the first step as input to update payroll files on disk.

(3) And the third step may be required to copy the newly created disk files to tape for backup purposes.

Illustration #1

Single Step Job(Run)

```
// JOB
// EXEC P19HRD
/*
/&
```

job steps (subsets)

Three Step Job(Run)

```
// JOB
// EXEC P19HRD
/*
// EXEC P2ØHRD
// EXEC P21HRD
/&
```

c. Software System: A software system is the collection of jobs, programs, and procedures used to support a specific application. Examples of a software system would be the applications that support the activities of a supply unit, a finance office or a personnel office.

The jobs within a software system are grouped together to perform different types of processing. One set of jobs may be for the updating of files daily, others may be for the printing of weekly, bimonthly or monthly reports. These sets of job(s) are referred to as cycles (See Illustration #2).

Illustration #2

Cycle	*Job (Run)*	*Program (Subset)*
FNDØ1 *(Daily Cycle)*	FNPE22	P1ØHRD P3ØHRD P35HRD
FNBØ1 *(Bimonthly Cycle)*	FNPE3Ø	PØ5HRD P15HRD P99HFN
FNMØ1 *(Monthly Cycle)*	FNPE42	P2ØHRD P4ØHRD P5ØHRD

(1) The first cycle of the system may be run daily to update the payroll files.

(2) The second cycle may be run twice a month to print payroll checks.

(3) And finally, the third cycle may be run monthly to print U. S. Savings Bonds.

The daily cycle and bimonthly cycle most likely will be run together twice a month, and all 3 cycles would be run once a month. The most effective way to insure that these jobs are ran, and to allow these jobs to be loaded at one time into the card reader, would be to batch the JCL for each cycle into a job stream (See Illustration #3).

Illustration #3

```
              // JOB FNPE22
              // EXEC P10HRD
Daily         /*
Cycle         // EXEC P30HRD
              // EXEC P35HRD
              /&
              // JOB FNPE30
              // EXEC P05HRD
Bimonthly     // EXEC P15HRD        Job
Cycle         // EXEC P99HFN        Stream
              /*
              /&
              // JOB FNPE42
              // EXEC P20HRD
Monthly       // EXEC P40HRD
Cycle         /*
              // EXEC P50HRD
              /&
```

2. Disk JCL: As a computer operator you will most likely see that the JCL that is required for a job or jobs will be placed on magnetic disk and will be retrieved, whenever required, by using just a few JCL cards.

Running a job or job stream may require numerous JCL statements (See Illustration #4). There would be a good chance that cards would be lost, or put out of sequence by constant handling.

Illustration #4

Job Stream

```
// JOB FNPE22
* P1ØHRD
// ASSGN
// ASSGN
// TLBL
// EXEC P1ØHRD
/*
* P3ØHRD
// ASSGN
// ASSGN
// TLBL
// DLBL
// EXTENT
// EXEC P3ØHRD
* P35HRD
// ASSGN
// ASSGN
// DLBL
// EXTENT
// TLBL
// EXEC P35HRD
/&
// JOB PNPE3Ø
* PØ5HRD
```

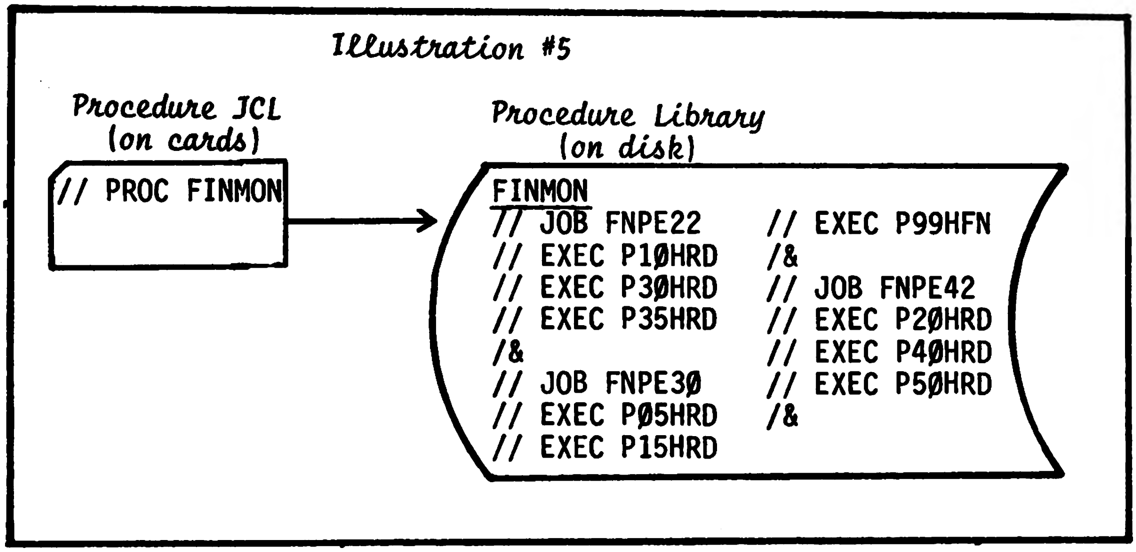
Job Stream (cont.)

```
// ASSGN
// ASSGN
// DLBL
// EXTENT
// DLBL
// EXTENT
// EXEC PØ5HRD
* P15HRD
// ASSGN
// ASSGN
// DLBL
// EXTENT
// EXEC P15HRD
* P99HFN
// ASSGN
// ASSGN
// DLBL
// EXTENT
// TLBL
// EXEC P99HFN
/*
/&
// JOB FNPE42
* P2ØHRD
```

Job Stream (cont.)

```
// ASSGN
// ASSGN
// DLBL
// EXTENT
// DLBL
// EXTENT
// EXEC P2ØHRD
* P4ØHRD
// ASSGN
// ASSGN
// DLBL
// EXTENT
// EXEC P4ØHRD
/*
* P5ØHRD
// ASSGN
// ASSGN
// DLBL
// EXTENT
// TLBL
// EXEC P5ØHRD
/&
```

Disk JCL resolves these problems by minimizing the amount of cards that the operator needs to handle. When using disk JCL there still must be a way to call in the JCL from magnetic disk, so the computer system can read the job stream. A common way of doing this is by using another type of JCL called "Procedure JCL" that will call in a set of JCL from a library on magnetic disk (See Illustration #5).



In looking at illustration #5 you can see that by using one procedure JCL statement, a complete job stream can be called in. The benefits of disk JCL are:

a. Reduction in card handling.

b. Increase efficiency (JCL is loaded into the system at the speed of magnetic disk rather than the slow speed of the card reader).

c. Savings in punch card storage requirements (Large quantities of JCL can be stored in a relatively small area on disk).

3. Multiprogramming: Multiprogramming is a technique of executing more than one program concurrently on a computer. If you remember in chapter 7, it stated that while one program was performing I/O operations, processing for another program could be accomplished. This is called multiprogramming.

a. Memory Requirements: Chapter 8 pointed out that each program that was to be used on a computer would normally be stored on magnetic disk, and whenever a particular program was needed for processing, it would be loaded into main memory. The amount of instructions and functions that a program has determines the amount of main memory required. If there isn't enough memory available in the computer for a particular program to be loaded, the DPA would not be able to use that program for processing.

In order to run a job on a computer system, there must be sufficient main memory available to run each step (program) of that job (See Illustration #6). Using illustration #6 as an example, we can see that the available memory of the computer system is 100K. Also shown is:

* That the first program requires 68K,

* The second program requires 100K,

* And the third program requires 102K.

This sample job could not be run on the system since the third job step requires more memory than is available.

When a programmer writes a program, consideration must be given to the size of the computer's main memory, and the amount of main memory that is required for the computer's control programs.

Illustration #6

Main Memory

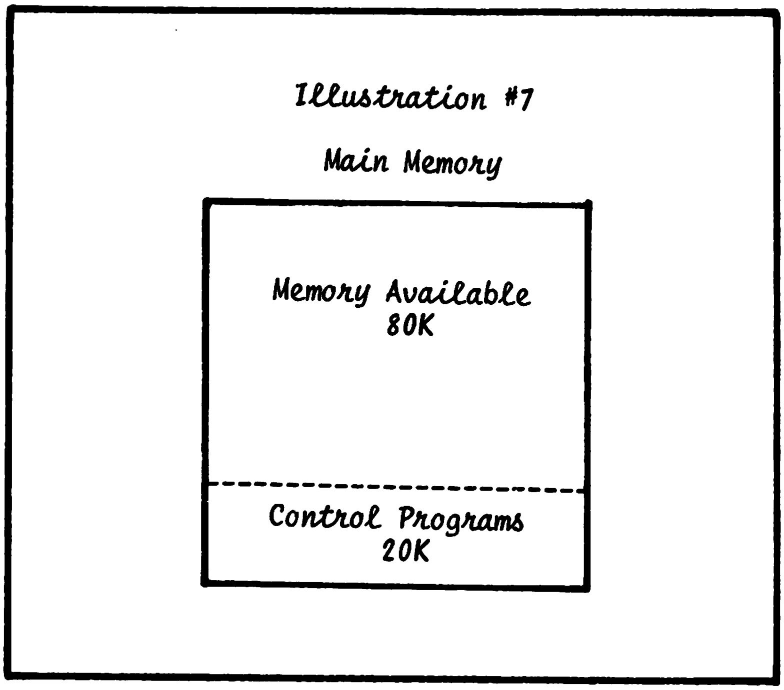
Memory Available

100K

Job steps — *Memory Requirements*

```
// JOB FNPE3Ø
// EXEC PØ5HRD . . . . (68K)
// EXEC P15HRD . . . . (100K)
// EXEC P99HFN . . . . (102K)
/*
/&
```

b. Control Programs: Manufacturers of computer systems provide control programs that must reside in main memory when the computer is active (processing). These control programs contain many routines that would otherwise have to be written into each application program (Routines such as those handling I/O operation requirements, arithmetic functions, compare functions, etc.). By the use of prewritten control programs, the programmer is saved a great deal of effort, the chance of programming errors is reduced, and a great deal of operator intervention is eliminated by taking care of basic I/O error recoveries. Because these control programs require memory, the amount of main memory available for processing is reduced (See Illustration #7).

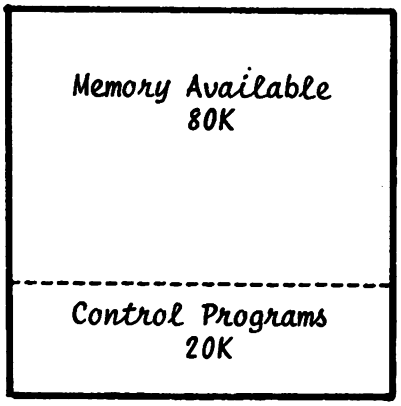


These control programs are known as an operating system.
(Refer to Chapter 8 on operating systems).

Once the programmers determine the amount of main memory available for processing, programs for a job will be written to fit in main memory (See Illustration #8).

Illustration #8

Main Memory



Job steps — *Memory Requirements*

```
// JOB FNPE3Ø
// EXEC PØ5HRD . . . . (68K)
// EXEC P15HRD . . . . (76K)
// EXEC P99HFN . . . . (80K)
/*
/&
```

c. Partitions: On some computer systems the available memory can be divided into partitions, so multiprogramming can be accomplished. This is called <u>allocating</u> memory on the computer. The purpose of allocating memory is to insure that when two programs are running, they don't try to use the same memory address (refer to chapter #6, main memory). To explain this further, let's say that we have 80K of available memory, and 20K that is being used by the operating system (control programs). Also there is one job to be processed, and it requires 40K of memory because its largest job step is 40K. This leaves 40K of memory available to process another job. This can be accomplished by allocating 40K to a partition and 40K to another partition (See Illustration #9).

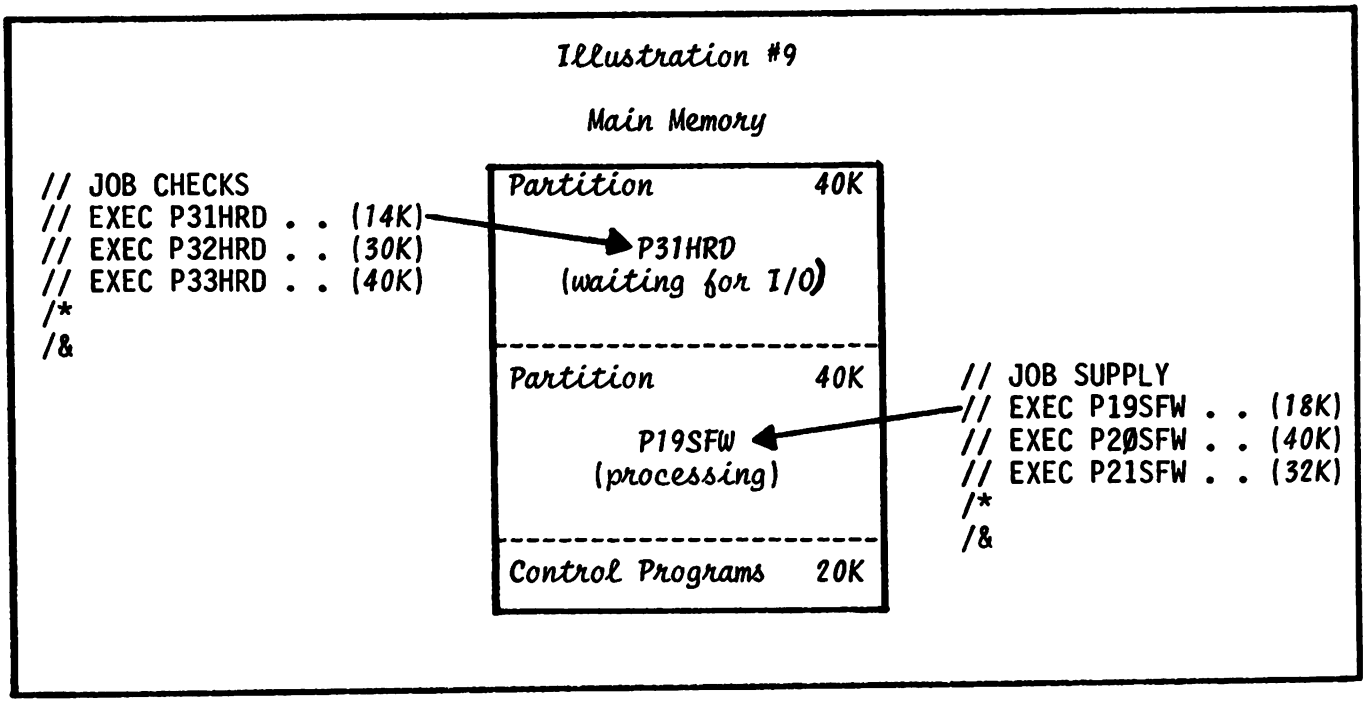
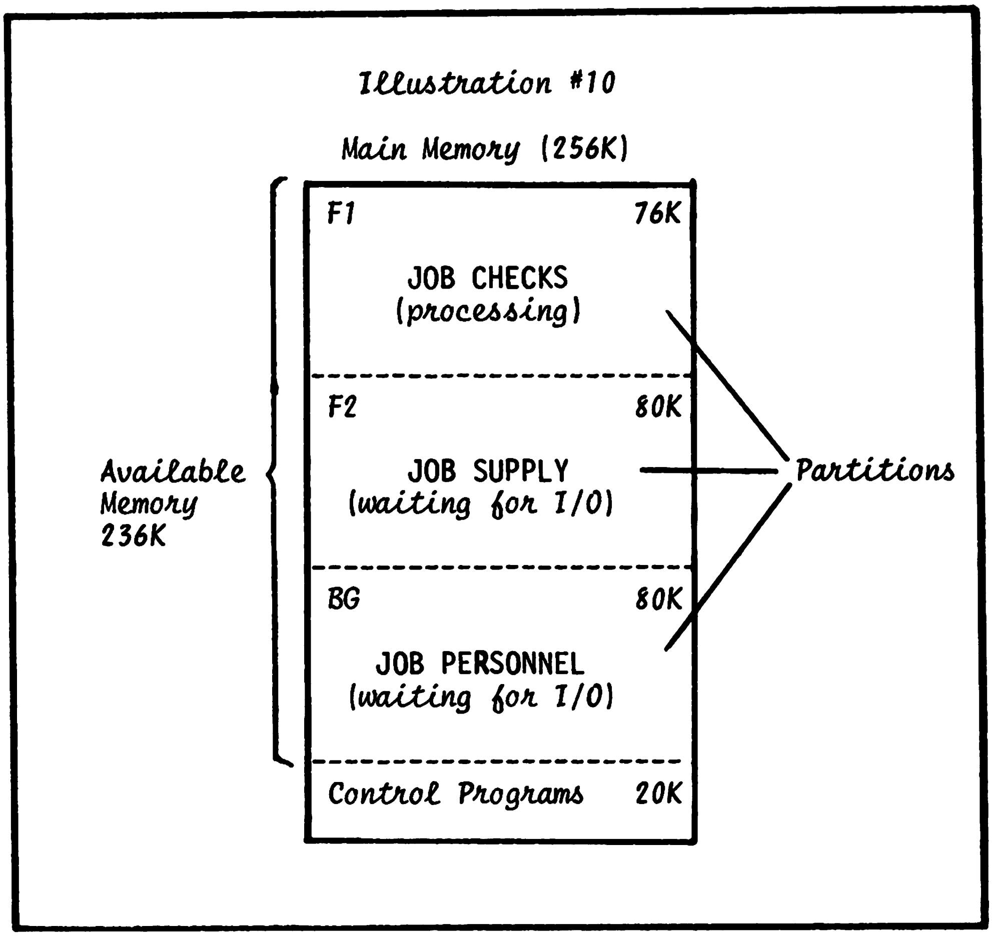


Illustration #9

(1) Partition Identifiers: Partition identifiers are used for identifying areas when allocating memory for processing of jobs, and to identify which area the operator is communicating with when issuing instructions or responding to messages from a particular partition. Here at the school these partitions are Foreground One (F1), Foreground Two (F2), and Background (BG), (See Illustration #10).



(2) Partition Priorities: Partition priorities give the DPA the capability of insuring that an important job, when being run in a multiprogramming environment, is given sufficient processing time.

A problem may occur when one job requires very little I/O and does not allow the second job very much processing time (this can, and does, happen when a job requires a lot of CPU activity). This problem is resolved by a control program specifying the priorities of the partitions. Partition priorities differ from one computer to another depending upon the operating system. Here at the school you will see that with one operating system (set of control programs), F1 will have the highest priority followed by F2, and BG will have the lowest priority. Another operating system that you will learn about, will allow the operator to change partition priorities.

4. Job Management: Before processing any job on a computer system, the operator must insure that the resources required for that job are available. This includes memory and any I/O devices required by that job.

a. Memory: In the last section of this chapter you learned that by allocating memory for partitions you can insure that enough memory is available for a job. Some operating systems will automatically allocate memory for jobs.

b. I/O Devices: In chapter 9 you learned that I/O devices can be assigned through the use of Job Control Language. In this case the operator would insure that the devices required by the documentation and JCL (both written by the programmer) are available.

DYNAMICALLY ASSIGNED: Depending upon the operating system, input/output devices can also be dynamically assigned. The programmer, instead of specifying a physical unit address, will only specify the type of device required. As an example, let's say that a programmer wrote a program with a tape file as input. For this tape file the programmer wrote the JCL to assign this tape file to a tape drive with a physical unit address of 280. When the job that this program is included in is processed, no other job that requires 280 can be processed at the same time. To have a tape drive dynamically assigned, the programmer would specify the device type instead of a physical unit address. In this case, the operating system would search all the tape drives, find an available tape drive (not being used), and make any necessary assignments automatically.

5. Spooling: Spooling is basically no more than diverting information (input or output) to a high speed device such as a disk or tape drive before it is sent to a low speed device, such as a printer or punch. Before we take a look at two types of spooling, let's take a look at why we have spooling.

First, let's look at an example of a computer system with one card reader, one card punch, and one printer. These devices can only be used by one job at a time. What do we do if two or more jobs require any one of these devices at the same time? The easy answer would be to run one job at a time. Spooling offers a better solution.

Second, since the speeds of card readers, card punches, and printers are measured in minutes, while the central processing unit can process information in excess of millionths of a second, a computer will only be able to process as fast as the slow speed devices allow it. Spooling will increase the processing time of a computer system.

a. Disk Spooling: With disk spooling information that is read in through the card reader is directed to an appropriate area on disk depending upon which partition is to be used. Printed and punched output will be directed to an area on disk depending upon the partition and what type of output (print or punch) it is (See Illustration #11). These areas on disk that represent card readers, punches, and printers are called queues.

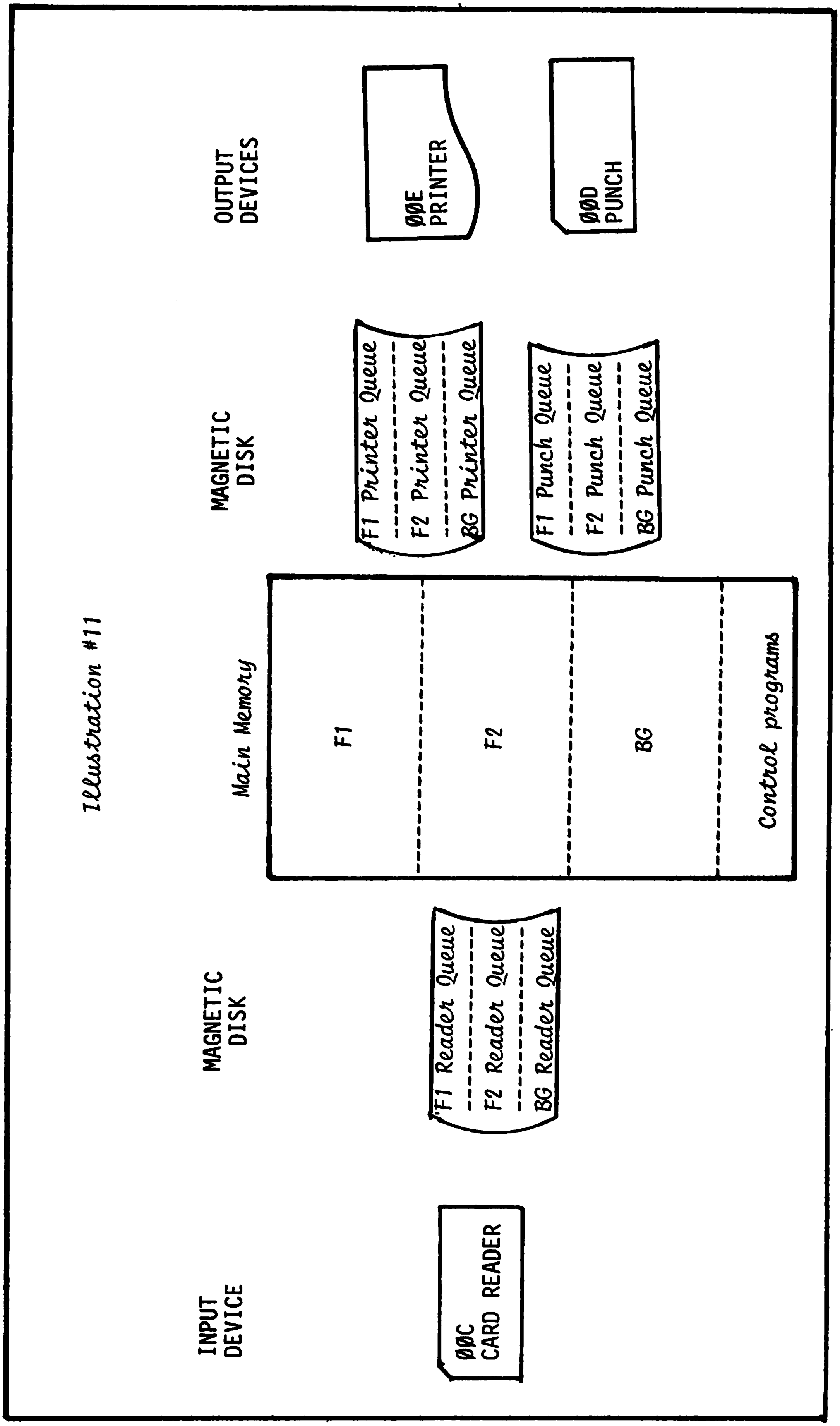


Illustration #11
INPUT DEVICE
ØØC CARD READER
MAGNETIC DISK
F1 Reader Queue
F2 Reader Queue
BG Reader Queue
Main Memory
F1
F2
BG
Control programs
MAGNETIC DISK
F1 Printer Queue
F2 Printer Queue
BG Printer Queue
F1 Punch Queue
F2 Punch Queue
BG Punch Queue
OUTPUT DEVICES
ØØE PRINTER
ØØD PUNCH

With disk spooling the operator is responsible for giving the proper commands for directing any card input to the appropriate queue, or direct printed and punched output to the actual printer or punch. Spooling allows us to share unit record devices (card readers, card punches, and printers) between different partitions. By using spooling these devices are simulated on disk.

b. Tape Spooling: The major difference between tape and disk spooling is that magnetic tape is used instead of magnetic disk.

6. Batch Processing: Batch processing is simply grouping or batching the JCL for one or more jobs together prior to processing and loading them into the computer at one time. Jobs and job steps are sequentially arranged. Processing flows from one step or job into the one that follows it.

7. Rerun/Restart: So far in this chapter you have read about running a job, but not what happens if a job fails, or does not process correctly. Many things can cause a job to cancel. An input/output device may have a hardware problem, the program may encounter data it cannot process, or the operator may accidentally cancel a job. If a job cancels, the operator will have to rerun the job or perform a job restart.

a. Rerun: A rerun involves starting a job over from the beginning. A common cause for this is using the wrong input either on tape, disk or cards. Or we run a job and find out that the output is garbage. For a rerun the job is run from the very beginning.

b. Restart: A restart involves starting a job from a point within the job stream. If a job cancels at step 5, we could possibly restart it at step 4. By doing a restart not as much time is lost, as would be lost for a rerun.

The programmer, through the documentation provided for each job, would supply the operator, the proper procedures to perform a rerun or a restart.

E. SUMMARY: In this chapter you learned basic concepts of how jobs are processed, and concepts of computer systems.

F. CONCLUSION: As a computer operator you need to identify the basic concepts that are mentioned in this chapter. Knowledge of these concepts will give you a good foundation for the rest of this course, and will give you valuable insight in determining requirements for running a job on the computer.

SELF EVALUATION

1. Multiprogramming is:

   a. A technique of writing two programs concurrently.

   b. A technique of processing more than one program within a job.

   c. A technique of executing more than one program concurrently on a computer.

2. Dividing main memory into partitions is called:

   a. selecting.

   b. separating.

   c. allocating.

   d. multiprogramming.

   e. division.

3. From the list below, select an advantage of Disk JCL.

   a. Increase effeciency.

   b. Multiprogramming can be accomplished.

   c. Less main memory is required to run a job.

   d. I/O devices can be dynamically assigned.

   e. Gives priority to the memory that is going to process the job.

4. A job stream is:

   a. Scheduling more than one job to be run on the computer.

   b. Two or more jobs placed together in one batch.

   c. Running two or more jobs on the computer at one time.

   d. Jobs that are identified to be destroyed.

5. A job step is:

   a. One job out of a series of jobs.

   b. Anyone of the JCL statements within a job.

   c. A program that is executed within a job.

   d. Is a program that prepares the computer for processing.

6. Memory area priority:

   a. Allows the operator to cancel jobs that are not important.

   b. Allows the operator to insure that the most improtant job is given processing time.

   c. Is used to identify which area the operator is communicating with.

7. Here at the school BG is:

   a. A memory area priority.

   b. A job step.

   c. A partition identifier.

   d. Used for Disk JCL.

8. The jobs within a software system are grouped together to perform different types of processing. These groups within a software system are referred to as:

   a. job steps.

   b. cycles.

   c. partions.

   d. I/O devices.

   e. Disk JCL.

9. With disk spooling information that is read in through the card reader is diverted to an appropriate area (depending upon the partition) on disk. This area on disk is called a __________.

   a. Run.

   b. Control program.

   c. Queue.

   d. Procedure JCL.

10. True or False. A job step consists of more than one program.

11. True or False. JCL stored on magnetic disk is called Disk JCL.

12. True or False. A huge amount of cards are required to pull a job stream from disk.

13. True or False. If a program requires more than the amount of memory in the computer it still can be processed, but only if memory has been allocated properly.

14. True or False. Memory areas must have the same priority.

15. True or False. Memory area identifiers are used to identify JCL.

16. True or False. A software system is the collection of jobs, programs and procedures used to support a specific application.

17. True or False. A part of main memory is used by the operating system.

18. True or False. Disk spooling uses areas on disk that represent card readers, card punches, and printers.

19. True or False. Batch processing is grouping the JCL for one or more jobs together prior to processing them.

20. True or False. If a job cancels, the operator will have to perform a job restart or rerun the job.

21. True or False. Before processing a job on a computer system, the operator does not have to insure that the resources required for that job are available.

NOTES

NOTES

APPENDIX A

SOLUTIONS

Chapter 1, Introduction to DP

Solution	Reference
1. c	2a
2. e,d	1a
3. b,c,e,f,g	3
4. a,d,g	2
5. a,c,d,f,h	2b
6. a,d,g	4c

Chapter 2, Punch Card Input and Output

1. c,e	1a,1c
2. e	1c
3. a,d,h	1a,1b,1c
4. b,e	1a,1c
5. a	2b
6. h	2c
7. b	5b
8. c,e	3a
9. b	4b
10. a	4a
11. CARD READERS ARE INPUT DEVICES	2b,2c
12. THE THREE BASIC ELEMENTS OF A DIGITAL COMPUTER ARE INPUT, PROCESSING, AND OUTPUT	2b,2c

Chapter 3, Computer Forms

1. e	1
2. c	3
3. b	2
4. d	4
5. c	4
6. b	5b
7. a	5a
8. b	5c
9. b	8
10. a	7
11. c	8a
12. c	9b(1)
13. b	9b(3)
14. e	9b(2)

SOLUTIONS

Solution	Reference
Chapter 3, (continued)	
15. false	11
16. b	6b
17. a,b,d	11
Chapter 4, Magnetic Tape Input and Output	
1. b	1c
2. a	1b
3. b	4
4. c	2f
5. b	2,2b
6. c	1b
7. c	3b(1),3b(2),3b(3)
8. c,d	2d
9. d	5
10. b	2a
11. c	2f
12. true	1b
13. true	2d,2e
14. true	2e
15. true	A
16. false	1d
17. true	2b(2)(d)
18. true	2b(2)(e)
19. true	3
20. true	3a(1),3b(1)
21. true	3b(2)
22. true	2b(e)
Chapter 5, Magnetic Disk Input and Output	
1. b	5f
2. a	1a
3. c	5d,5e
4. c	1b
5. b	3b
6. c	3c
7. false	A
8. true	1
9. false	1
10. true	1
11. true	1

SOLUTIONS

Solutions	Reference
Chapter 5 (continued)	
12. true	3b
13. false	6
14. false	6
15. d	2
Chapter 6, The Central Processing Unit	
1. b	2
2. c	3
3. b	1
4. a	4
5. d	6
6. true	1
7. true	1
8. true	A
9. true	4
Chapter 7, Channels, Control Units and Physical Unit Addresses	
1. c	4
2. b	2b
3. c	4
4. a	5
5. a	3b
6. b	1
7. b	6
8. false	4
9. true	4
10. false	D
11. true	1
12. true	2
13. true	3b
14. true	3a
15. true	1
16. false	1b
17. true	3b
18. true	4a

SOLUTIONS

Chapter 8, Computer Programs

Solution	Reference
1. c	1
2. b	1
3. a	1
4. d	1
5. a	2
6. c	3
7. d	4
8. b	5
9. d	6a
10. b	6b
11. a	7

Chapter 9, Job Control Language

1. b	2
2. e	2f
3. a	2a
4. g	2d
5. b	A
6. f	2i
7. c	2g
8. g	2c
9. c	1
10. d	2b
11. b	2h
12. true	1b
13. false	2a
14. false	2b
15. true	2c
16. false	2f
17. true	2e

SOLUTIONS

Chapter 10, Concepts in Computer Processing

Solution	Reference
1. c	3
2. c	3c
3. a	3c
4. b	1
5. c	1b
6. b	1c(2)
7. c	3c(1)
8. b	1c
9. c	5a
10. false	1b
11. true	2
12. false	2
13. false	3a
14. false	3c(2)
15. false	3c(1)
16. true	1c
17. true	3b
18. true	5a
19. true	6
20. true	7
21. false	4

NOTES

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